

**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**ANALYTICAL CHEMISTRY TECHNICIAN**

**LEVEL 6**



**TVET CDACC**

**P.O BOX 15745-00100**

**NAIROBI**

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# FOREWORD

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

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that these Occupational Standards were developed for developing a competency-based curriculum for Analytical Chemistry level 6. These Occupational Standards will also be the bases for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a great role towards development of competent human resource for the 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 to reform curriculum development, assessment and certification. This called for shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Analytical Chemistry Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for an analytical Chemistry technician. These occupational standards will be the bases for development of competency-based curriculum for Analytical Chemistry Level 6. These Standards will also be the bases for assessment of an individual for competence certification.

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

I am grateful to the Council Members, Council Secretariat, Analytical Chemistry SSAC, expert workers and all those who participated in the development of these occupational standards.

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

**CHAIRMAN, TVET CDACC**

# ACKNOWLEDGMENT

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

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to the Analytical Chemistry Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards.

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

**CHAIRPERSON**

**ANALYTICAL CHEMISTRY SECTOR SKILLS ADVISORY COMMITTEE**

# ACRONYMS

2D : Two Dimensional

ACHEM : Analytical Chemistry

AIDS : Acquired Immune Deficiency Syndrome

ASC : Applied Science

BC : Basic Competency

CC : Common Competency

CDACC : Curriculum Development, Assessment and Certification Council

CR : Core Competency

CU : Curriculum

HIV : Human Immuno-Deficiency Virus

ICT : Information Communication Technology

LCD : Liquid Crystal Display

NEMA : National Environmental Management Authority

OSHA : Occupation Safety and Health Act

OSHS : Occupation Safety and Health Standards

PESTEL : Political Economic Social Technological Environmental and Legal

PPE : Personal Protective Equipment

SSAC : Sector Skills Advisory Committee

SWOT : Strengths Weaknesses Opportunities and Threats

TVET : Technical and Vocational Education and Training

# KEY TO UNIT CODE

 **ASC/OS/ACHEM/BC/01/6**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

#

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# OVERVIEW

Analytical Chemistry Level 6 qualification consists of competencies that an individual must achieve to enable him/her to apply analytical chemistry skills in a work place. It entails preparation of research concept, design and data collection tools, Collection and management of research data, Descriptive data analysis, inferential data analysis, experimental research designs, improvement of industrial Process quality.

**BASIC COMPETENCIES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Competency Code** | **Unit of Competency Title** | **Duration in hours** | **Credit factor** |
| ASC/OS/ACHEM/BC/01/6/A | Demonstrate communication skills | 40 | 4 |
| ASC/OS/ACHEM/BC/02/6/A | Demonstrate numeracy skills | 100 | 6 |
| ASC/OS/ACHEM/BC/03/6/A | Demonstrate digital literacy | 60 | 6 |
| ASC/OS/ACHEM/BC/04/6/A | Demonstrate entrepreneurial skills | 100 | 10 |
| ASC/OS/ACHEM/BC/05/6/A | Demonstrate employability skills | 80 | 8 |
| ASC/OS/ACHEM/BC/06/6/A | Demonstrate environmental literacy | 40 | 4 |
| ASC/OS/ACHEM/BC/07/6/A | Demonstrate occupational safety and health practices | 40 | 4 |
| **Total** | **460** | **46** |

**COMMON COMPETENCY**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in hours** | **Credit Factor** |
| ASC/OS/ACHEM/CC/01/6/A | Apply physics science | 44 | 4.4 |
| ASC/OS/ACHEM/CC/02/6/A | Apply standard laboratory practices | 44 | 4.4 |
| ASC/OS/ACHEM/CC/03/6/A | Apply inorganic chemistry | 142 | 14.2 |
| ASC/OS/ACHEM/CC/04/6/A | Apply physical chemistry | 142 | 14.2 |
| ASC/OS/ACHEM/CC/05/6/A | Apply organic chemistry | 142 | 14.2 |
| ASC/OS/ACHEM/CC/06/6/A | Apply biochemistry techniques | 142 | 14.2 |
| ASC/OS/ACHEM/CC/07/6/A | Apply statistical method | 4.4 | 4.4 |
| ASC/OS/ACHEM/CC/08/6/A | Apply analytical chemistry research | 99 | 9.9 |
| ***TOTAL*** | **799** | **79.9** |

**CORE COMPENTENCIES**

| **Unit of Competency Code** | **Unit of Competency Title** | **Duration in hours**  | **Credit factor**  |
| --- | --- | --- | --- |
| ASC/CU/ACHEM/CR/01/6/A | Develop standard operating test procedures | **99** | **9.9** |
| ASC/CU/ACHEM/CR/02/6/A | Perform analytical chemistry tests procedures | **99** | **9.9** |
| ASC/CU/ACHEM/CR/03/6/A | collect and prepare analytical chemistry samples | **160** | **16.0** |
| ASC/CU/ACHEM/CR/04/6/A | Analyse and interpret analytical chemistry data | **99** | **9.9** |
| ASC/CU/ACHEM/CR/05/6/A | Manage analytical chemistry laboratory, reagents and instruments  | **99** | **9.9** |
| ASC/CU/ACHEM/CR/06/6/A | Manage analytical chemistry samples | **99** | **9.9** |
|  | Industrial attachment | **480** | **48** |
|  | Analytical chemistry Project  | **56** | **5.6** |
| **Total** | **1576** | **15.76** |
| **Grand total** | **2976** | **29.76** |

# BASIC UNITS OF COMPETENCY

## DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE: COS/OS/HD/BC/01/6**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Meet communication needs of clients and colleagues
 | 1.1 Specific communication needs of clients and colleagues are identified and met1.2 Different approaches are used to meet communication needs of clients and colleagues1.3 Conflict is addressed promptly and in a timely way and in a manner, which does not compromise the standing of the organization |
| 1. Develop communication strategies
 | * 1. Strategies for effective internal and external dissemination of information are developed to meet the organization’s requirements
	2. Special communication needs are considered in developing strategies to avoid discrimination in the workplace
	3. Communication ***strategies*** are analyzed, evaluated and revised where necessary to make sure they are effective
 |
| 1. Establish and maintain communication pathways
 | * 1. Pathways of communication are established to meet requirements of organization and workforce
	2. Pathways are maintained and reviewed to ensure personnel are informed of relevant information
 |
| 1. Promote use of communication strategies
 | * 1. Information is provided to all areas of the organization to facilitate implementation of the strategy
	2. Effective communication techniques are articulated and modelled to the workforce
	3. Personnel are given guidance about adapting communication strategies to suit a range of contexts
 |
| 1. Conduct interview
 | 1. A range of appropriate communication strategies are employed in ***interview situations***
2. Records of interviews are made and maintained in accordance with organizational procedures
3. Effective questioning, listening and nonverbal communication techniques are used to ensure that required message is communicated
 |
| 1. Facilitate group discussion
 | * 1. Mechanisms which enhance ***effective group interaction*** is defined and implemented
	2. Strategies which encourage all group members to participate are used routinely
	3. Objectives and agenda for meetings and discussions are routinely set and followed
	4. Relevant information is provided to group to facilitate outcomes
	5. Evaluation of group communication strategies is undertaken to promote participation of all parties
	6. Specific communication needs of individuals are identified and addressed
 |
| 1. Represent the organization
 | 7.1 When participating in internal or external forums, presentation is relevant, appropriately researched and presented in a manner to promote the organization 7.2 Presentation is clear and sequential and delivered within a predetermined time 7.3 Appropriate media is utilized to enhance presentation 7.4 Differences in views are respected7.5 Written communication is consistent with organizational standards 7.6 Inquiries are responded in a manner consistent with organizational standard |

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Effective communication
* Active listening
* Giving/receiving feedback
* Interpretation of information
* Role boundaries setting
* Negotiation
* Establishing empathy
* Openness and flexibility in communication
* Communication skills required to fulfil job roles as specified by the organization
* Writing communications strategy
* Applying key elements of communications strategy

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups and different styles of group leadership
* Communication skills relevant to client groups
* Flexibility in communication
* Communication skills relevant to client groups

Key elements of communications strategy

EVIDENCE GUIDE

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

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

## DEMONSTRATE NUMERACY SKILLS

**UNIT CODE: COS/OS/HD/BC/02/6**

**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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms*** ***are elaborated in the Range.*** |
| 1. Apply a wide range of mathematical calculations for work | 1.1 Mathematical information embedded in a range of workplace tasks and texts is extracted1.2 Mathematical information is interpreted and comprehended1.3 A range of mathematical and problem solving processes are select and used1.4 Different forms of fractions, decimals and percentages are flexibly used1.5 Calculation performed with positive and negative numbers1.6 Numbers are expressed as powers and roots and are used in calculations1.7 Calculations done using routine formulas1.8 Estimation and assessment processes are used to check outcome1.9 Mathematical language is used to discuss and explain the processes, results and implications of the task |
| 2. Use and apply ratios, rates and proportions for work | 2.1 Information regarding ratios, rates and proportions extracted from a range of workplace tasks and texts2.2 Mathematical information related to ratios, rate and proportions is analysed2.3 Problem solving processes are used to undertake the task2.4 Equivalent ratios and rates are simplified2.5 Quantities are calculated using ratios, rates and proportions2.6 Graphs, charts or tables are constructed to represent ratios, rates and proportions2.6 The outcomes reviewed and checked2.7 Information is record using mathematical language and symbols |
| 3. Estimate, measure and calculate measurement for work | 1. Measurement information embedded in workplace texts and tasks are extracted and interpreted
2. Appropriate workplace measuring equipment are identified and selected
3. Accurate measurements are estimate and made
4. The area of 2D shapes including compound shapes are calculated
5. The volume of 3D shapes is calculated using relevant formulas
6. Sides of right angled triangles are calculated using Pythagoras’ theorem
7. conversions are perform between units of measurement
8. Problem solving processes are used to undertake the task
9. The measurement outcomes are reviewed and checked
10. Information is recorded using mathematical language and symbols appropriate for the task
 |
| 4. Use detailed maps to plan travel routes for work | 4.1 Different types of maps are identified and interpreted4.2 Key features of maps are identified4.3 Scales are identified and interpreted4.4 Scales are applied to calculate actual distances4.5 Positions or locations are determined using directional information4.6 Routes are planned by determining directions and calculating distances, speeds and times4.7 Information is gathered and identified and relevant factors related to planning a route checked4.8 Relevant equipment is select and checked for accuracy and operational effectiveness4.9 Task is planned and recorded using specialized mathematical language and symbols appropriate for the task |
| 5. Use geometry to draw 2D shapes and construct 3D shapes for work | 5.1 A range of 2D shapes and 3D shapes and their uses in work contexts is identified5.2 Features of 2D and 3D shapes are named and described5.3 Types of angles in 2D and 3D shapes are identified5.4 Angles are drawn, estimated and measured using geometric instruments5.5 Angle properties of 2D shapes are named and identified5.6 Angle properties are used to evaluate unknown angles in shapes5.7 Properties of perpendicular and parallel lines are applied to shapes5.8 Understanding and use of symmetry is demonstrated5.9 Understanding and use of similarity is demonstrated5.10 The workplace tasks and mathematical processes required are identified5.11 2D shapes is drawn for work5.12 3D shapes is constructed for work5.13 The outcomes are reviewed and checked5.14 Specialized mathematical language and symbols appropriate for the task are used |
| 6. Collect, organize, and interpret statistical data for work | 6.1 Workplace issue requiring investigation are identified6.2 Audience / population / sample unit is determined6.3 Data to be collected is identified6.4 Data collection method is selected6.5 Appropriate statistical data is collected and organized6.6 Data is illustrated in appropriate formats6.7 The effectiveness of different types of graphs are compared6.8 The summary statistics for collected data is calculated6.9 The results / findings are interpreted6.10 Data is checked to ensure that it meets the expected results and content6.11 Information from the results including tables, graphs and summary statistics is extracted and interpreted6.12 Mathematical language and symbols are used to report results of investigation |
| 7. Use routine formula and algebraic expressions for work | 7.1 Understanding of informal and symbolic notation, representation and conventions of algebraic expressions is demonstrated7.2 Simple algebraic expressions and equations are developed7.3 Operate on algebraic expressions7.4 Algebraic expressions are simplified 7.5 Substitution into simple routine equations is done7.6 Routine formulas used for work tasks are identified and comprehended7.7 Routine formulas are evaluate by substitution7.8 Routine formulas transposed7.9 Appropriate formulas are identified and used for work related tasks7.10Outcomes are checked and result of calculation used |
| 8. Use common functions of a scientific calculator for work | 8.1 Required numerical information to perform tasks is located8.2 The order of operations and function keys necessary to solve mathematical calculation are determined8.3 Function keys on a scientific calculator are identified and used8.4 Estimations are referred to check reasonableness of problem solving process8.5 Appropriate mathematical language, symbols and conventions are used to report results |

RANGE

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Geometry
 | May include but not limited to:1. Scale drawing
2. Triangles
3. Simple solid
4. Round
5. Square
6. Rectangular
7. Triangle
8. Sphere
9. Cylinder
10. Cube
11. Polygons
12. Cuboids
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Applying Fundamental operations (addition, subtraction, division, multiplication)
* Using calculator
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1.      Critical aspects of Competency | Assessment requires evidence that the candidate:1. Applied a wide range of mathematical calculations for work
2. Demonstrated the ability to use and apply ratios, rates and proportions for work
3. Estimated, measured and calculated measurement for work
4. Demonstrated the ability to use detailed maps to plan travel routes for work
5. Demonstrated the ability to use geometry to draw 2D shapes and construct 3D shapes for work
6. Collected, organized, and interpreted statistical data for work
7. Demonstrated the ability to use routine formula and algebraic expressions for work.
 |
| 2.      Resource Implications | 2.1 Calculator* 1. Basic measuring instruments
 |
| 3.      Methods of Assessment | Competency may be assessed through:3.1 Written Test3.2 Interview/Oral Questioning* 1. Demonstration
 |
| 4.      Context of Assessment | Competency may be assessed in an off the job setting  |
| 5.      Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |
|  |  |

## DEMONSTRATE DIGITAL LITERACY

**UNIT CODE: COS/OS/HD/BC/03/6**

**UNIT DESCRIPTION**

This unit covers the competencies required to effectively use digital devices such as smartphones, tablets, laptops and desktop PCs. It entails identifying and using digital devices such as smartphones, tablets, laptops and desktop PCs for purposes of communication, work performance and management at the work place.

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| ***Appropriate computer software*** may include but not limited to: | A collection of instructions or computer tools that enable the user to interact with a *computer*, its hardware, or perform tasks.  |
| ***Appropriate computer hardware*** may include but not limited to: | Collection of physical parts of a computer system such as;* Computer case, monitor, keyboard, and mouse
* All the parts inside the computer case, such as the hard disk drive, motherboard and video card
 |
| ***Data security and privacy*** may include but not limited to: | * Confidentiality of data
* Cloud computing
* Integrity -but-curious data surfing
 |
| ***Security and control measures*** may include but not limited to: | * Counter measures against cyber terrorism
* Risk reduction
* Cyber threat issues
* Risk management
* Pass-wording
 |
| ***Security threats*** may include but not limited to: | * Cyber terrorism
* Hacking
 |
| ***Word processing concepts*** may include but not limited to: | Using a special program to create, edit and print documents |
| ***Network configuration*** may include but not limited to: | Organizing and maintaining information on the components of a computer network |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE** **GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Identified and controlled security threats
	2. Detected and protected computer crimes
	3. Applied word processing in office tasks
	4. Designed, prepared work sheet and applied data to the cells in accordance to workplace procedures
	5. Opened electronic mail for office communication as per workplace procedure
	6. Installed internet and World Wide Web for office tasks in accordance with office procedures
	7. Integrated emerging issues in computer ICT applications
	8. Applied laws governing protection of ICT
 |
| 1. Resource Implications
 | * 1. Tablets
	2. Laptops and
	3. Desktop PCs
	4. Desktop computer
	5. Lap top
	6. Calculator
	7. Internet
	8. Smart phone
	9. Operations Manuals
 |
| 1. Methods of Assessment
 | Competency may be assessed through:* 1. Written Test
	2. Demonstration
	3. Practical assignment
	4. Interview/Oral Questioning
	5. Demonstration
 |
| 1. Context of Assessment
 | Competency may be assessed in an off and on the job setting |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE understanding OF ENTREPRENEURSHIP

**UNIT CODE :** ED/OS/TT/BC/01/6

**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.

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

| **Variable** | **Range** include but not limited to: |
| --- | --- |
| 1. Types of entrepreneurs but not limited to:
 | 1. Innovators
2. Imitators
3. Craft
4. Opportunistic
5. Speculators
 |
| 1. Principles of Entrepreneurship but not limited to:
 | 1. Visionary
2. Solution provider
3. Accountability
4. Growth and marketing
5. Resilient
6. Tenacious
 |
| 1. Characteristics of Entrepreneurs include but not limited to:
 | 1. Creative
2. Innovative
3. Planner
4. Risk taker
5. Networker
6. Confident
7. Flexible
8. Persistent
9. Patient
10. Independent
11. Future oriented
12. Goal oriented
 |
| 1. Requirements for entry into self-employment
 | 1. Technical skills
2. Management skills
3. Entrepreneurial skills
4. Resources
5. Infrastructure
 |
| 1. Internal motivation includes but not limited to:
 | 1. Interest
2. Passion
3. Freedom
4. Prestige
 |
| 1. Business environment
 | 1. External
2. Internal
3. Intermediate
 |
| 1. Forms of businesses
 | 1. Sole proprietorship
2. Partnership
3. Limited companies
4. Cooperatives
 |
| 1. Governing policies
 | 1. Increasing scope for finance
2. Promoting cooperation between entrepreneurs and private sector
3. Reducing regulatory burden on entrepreneurs
4. Developing IT tools for entrepreneurs
 |
| 1. External motivation includes but not limited to:
 | 1. Rewards
2. Punishment
3. Enabling environment
4. Government policies
 |
| 1. Entrepreneurial orientation includes but not limited to:
 | 1. Passion
2. Interest
3. Hobbies
4. Skills
 |
| 1. Innovative business strategies include but not limited to:
 | 1. New products
2. New methods of production
3. New markets
4. New sources of supplies
5. Change in industrialization
 |
| 1. Communication principles include but not limited to:
 | 1. Feed back
2. Attention
3. Clarity
4. Timeliness
5. Adequacy
6. Consistency
7. Informality
 |
| 1. Motivational theories include but not limited to:
 | 1. Marslows
2. theory
3. McClelland theory
4. Fredrick Tylor’s theory
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Assessing a range of alternative products and strategies
* Critically analyzing information, summarizing and making sense of previous and current market trends
* Identifying changing consumer preferences and demographics
* Thinking “outside the box”
* Ensuring quality consistency
* Reducing lead time to product/service delivery
* Management
* Using formal problem-solving procedures, e. g., root-cause analysis, six sigma
* Communication
* Applying motivational principles, e. g., positive stroking, behavior modification
* Assessing range of alternatives rather than choosing the easiest option
* Achieving ownership and credibility for the enterprise vision
* Critically analyzing information, summarizing and making sense of previous and current market trends
* Developing solutions and practical strategies which are “outside the box”

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:1. Distinguished entrepreneurs and business persons correctly
2. Identified ways of becoming an entrepreneur appropriately
3. Explored factors affecting entrepreneurship development appropriately
4. Analysed importance of self-employment accurately
5. Identified requirements for entry into self-employment correctly
6. Identified sources of business ideas correctly
7. GeneratedBusiness ideas and opportunities correctly
8. Analysed business life cycle accurately
9. Identified legal aspects of business correctly
10. Assessed product demand accurately
11. Determined Internal and external motivation factors appropriately
12. Carried out communications effectively
13. Identified sources of business finance correctly
14. Determined Governing policy on small scale enterprise appropriately
15. Explored problems of starting and operating SSEs effectively
16. Developed Marketing, Organizational/Management, Production/Operation and Financial plans correctly
17. Prepared executive summary correctly
18. Determined business innovative strategies appropriately
19. Presented business plan effectively
 |
| 1. Resource Implications
 | The following resources should be provided:1. Check list
2. Research tools (Questionnaire, interview guide, observation schedule)
3. Materials, tools, equipment and machines relevant
 |
| 1. Methods of Assessment
 | 1. Written tests
2. Observation
3. Oral questions
4. Third party report
5. Interviews
6. Case problems
7. Portfolio
 |
| 1. Context of Assessment
 | 1. Competency may be assessed in workplace or in a simulated workplace setting
2. Assessment shall be observed while tasks are being undertaken whether individually or in-group
 |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE EMPLOYABILITY SKILLS

**UNIT CODE: COS/OS/HD/BC/05/6**

**UNIT DESCRIPTON**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Conduct self-management
 | 1. Personal vision, mission and goals are formulated based on potential and in relation to organization objectives
2. Emotions are managed as per workplace requirements
3. Individual performance is evaluated and monitored according to the agreed targets.
4. Assertiveness is developed and maintained based on the requirements of the job.
5. Accountability and responsibility for own actions are demonstrated.
6. Self-esteem and a positive self-image are developed and maintained.
7. Time management, attendance and punctuality are observed as per the organization policy.
8. Goals are managed as per the organization’s objective
9. Self-strengths and weaknesses are identified as per ***personal objectives***
10. Critics are managed as per personal objectives
 |
| 1. Demonstrate interpersonal communication
 | 1. Listening and understanding is demonstrated as per communication policy
2. Writing to the needs of the audience is demonstrated as per communication policy
3. Speaking, reading and writing is demonstrated as per communication policy
4. Negotiation skills are demonstrated as per communication policy
5. Empathizing is demonstrated as per the communication policy
6. Numeracy is applied as per the communication policy
7. Internal and external customers’ needs are identified and interpreted as per the communication policy
8. Persuasion is demonstrated as per the communication policy
9. Communication nnetworks are established as per the SOPs
10. Information is shared as per communication structure
 |
| 1. Demonstrate critical safe work habits
 | * 1. Stress is managed in accordance with workplace procedures.
	2. Punctuality and time consciousness is demonstrated in line with workplace policy.
	3. Personal objectives are integrated with organization goals based on organization’s strategic plan.
	4. ***Resources*** are utilized in accordance with workplace policy.
	5. Work priorities are set in accordance to workplace procedures.
	6. Leisure time is recognized in line with organization policy.
	7. Abstinence from ***drug and substance abuse*** is observed as per workplace policy.
	8. Awareness of HIV and AIDS is demonstrated in line with workplace requirements.
	9. Safety consciousness is demonstrated in the workplace based on organization safety policy.
	10. ***Emerging issues*** are dealt with in accordance with organization policy.
 |
| 1. Lead a workplace team
 | 1. Performance expectations for the ***team*** are set
2. Duties and responsibilities are assigned in accordance with the organization policy.
3. Team parameters and ***relationships*** are identified according to set rules and regulations.
4. ***Forms of communication*** in a team are established according to office policy.
5. Communication is carried out as per workplace place policy and requirements of the job.
6. Team performance is supervised
7. ***Feedback*** on performance is collected and analyzed based on established team learning process
8. Conflicts are resolved between team members in line with organization rules and regulations.
9. ***Gender mainstreaming*** is undertaken in accordance with set regulations.
10. Human rights are adhered to in accordance with existing protocol.
11. Healthy relationships are developed and maintained for harmonious co-existence in line with workplace.
 |
| 1. Plan and organize work
 | 1. Task requirements are identified as per the workplace objectives
2. Task is interpreted in accordance with safety (OHS ), environmental requirements and quality requirements
3. Work activity is organized with other involved personnel as per the SOPs
4. Resources are mobilized, allocated and utilized to meet project goals and deliverables.
5. Work activities are monitored and evaluated in line with organization procedures.
6. Job planning is documented in accordance with workplace requirements.
7. Planning and organizing of work activities is reviewed as per the workplace requirements
8. Time is managed achieve workplace set goals and objectives.
 |
| 1. Maintain professional growth and development
 | * 1. Personal training needs are identified and assessed in line with the requirements of the job.
	2. ***Training and career opportunities*** are identified and availed based on job requirements.
	3. Resources for training are mobilized and allocated based organizations skills needs.
	4. Licensees and certifications relevant to job and career are obtained and renewed.
	5. ***Personal growth*** is pursued towards improving the qualifications set for the profession.
	6. Work priorities and commitments are managed based on requirement of the job and workplace policy.
	7. Recognitions are sought as proof of career advancement in line with professional requirements.
 |
| 1. Demonstrate workplace learning
 | * 1. Own learning is managed as per workplace policy.
	2. Learning opportunities are sought and allocated based on job requirement and in line with organization policy.
	3. Contribution to the learning community at the workplace is carried out.
	4. ***Range of media for learning*** are established as per the training need
	5. Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job
	6. Enthusiasm for ongoing learning is demonstrated
	7. Time and effort are invested in learning new skills-based job requirements
	8. Willingness to learn in different context is demonstrated based on available learning opportunities arising in the workplace.
	9. Awareness of Occupational Health and Safety procedures are demonstrated in use of technology in the workplace.
	10. Initiative is taken to create more effective and efficient processes and procedures in line with workplace policy.
	11. New systems are developed and maintained in accordance with the requirements of the job.
	12. Opportunities that are not obvious are identified and exploited in line with organization objectives.
	13. Opportunities for performance improvement are identified proactively in area of work.
	14. Awareness of personal role in workplace ***innovation*** is demonstrated.
 |
| 1. Demonstrate problem solving skills
 | * 1. Creative, innovative and practical solutions are developed based on the problem
	2. Independence and initiative in identifying and solving problems is demonstrated.
	3. Team problems are solved as per the workplace guidelines
	4. Problem solving strategies are applied as per the workplace guidelines
	5. Problems are analyzed and assumptions tested as per the context of data and circumstances
 |
| 1. Manage workplace ethics
 | * 1. Policies and guidelines are observed as per the workplace requirements
	2. Self-worth and profession are exercised in line with personal goals and organizational policies
	3. Code of conduct is observed as per the workplace requirements
	4. Personal and professional integrity is demonstrated as per the personal goals
	5. Commitment to jurisdictional laws is demonstrated as per the workplace requirements
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Range** | **Variable** |
| ***Drug and substance abuse*** include but not limited to: | Commonly abused* Alcohol
* Tobacco
* Miraa
* Over-the-counter drugs
* Cocaine
* Bhang
* Glue
 |
| ***Feedback*** includes but not limited to: | * Verbal
* Written
* Informal
* Formal
 |
| ***Relationships*** includes but not limited to: | * Man/Woman
* Trainer/trainee
* Employee/employer
* Client/service provider
* Husband/wife
* Boy/girl
* Parent/child
* Sibling relationships
 |
| ***Forms of communication*** include but not limited to: | * Written
* Visual
* Verbal
* Non verbal
* Formal and informal
 |
| ***Team*** includes but not limited to: | * Small work group
* Staff in a section/department
* Inter-agency group
 |
| ***Personal growth*** includes but not limited to: |

|  |
| --- |
| * Growth in the job
* Career mobility
* Gains and exposure the job gives
* Net workings
* Benefits that accrue to the individual as a result of noteworthy performance
 |

 |
| ***Personal objectives*** include but not limited to: | * Long term
* Short term
* Broad
* Specific
 |
| ***Trainings and career opportunities*** includes but not limited to | * Participation in training programs
* Technical
* Supervisory
* Managerial
* Continuing Education
* Serving as Resource Persons in conferences and workshops
 |
| ***Resource*** include but not limited to: | * Human
* Financial
* Technology
* Hardware
* Software
 |
| ***Innovation*** include but not limited to: | * New ideas
* Original ideas
* Different ideas
* Methods/procedures
* Processes
* New tools
 |
| ***Emerging issues*** include but not limited to: | * Terrorism
* Social media
* National cohesion
* Open offices
 |
| ***Range of media for learning*** include but not limited to:  | * Mentoring
* peer support and networking
* IT and courses
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Personal hygiene practices
* Intra and Interpersonal skills
* Communication skills
* Knowledge management
* Interpersonal skills
* Critical thinking skills
* Observation skills
* Organizing skills
* Negotiation skills
* Monitoring skills
* Evaluation skills
* Record keeping skills
* Problem solving skills
* Decision Making skills
* Resource utilization skills
* Resource mobilization skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Work values and ethics
* Company policies
* Company operations, procedures and standards
* Occupational Health and safety procedures
* Fundamental rights at work
* Personal hygiene practices
* Workplace communication
* Concept of time
* Time management
* Decision making
* Types of resources
* Work planning
* Resources and allocating resources
* Organizing work
* Monitoring and evaluation
* Record keeping
* Workplace problems and how to deal with them
* Negotiation
* Assertiveness
* Team work
* Gender mainstreaming
* HIV and AIDS
* Drug and substance abuse
1. Leadership
2. Safe work habits
3. Professional growth and development
4. Technology in the workplace
5. Learning
6. Creativity
7. Innovation
8. Emerging issues
	* Social media
	* Terrorism
	* National cohesion

EVIDENCE GUIDE

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Conducted self-management
	2. Demonstrated interpersonal communication
	3. Demonstrated critical safe work habits
	4. Demonstrated the ability to lead a workplace team
	5. Planned and organized work
	6. Maintained professional growth and development
	7. Demonstrated workplace learning
	8. Demonstrated problem solving skills
	9. Demonstrated the ability to manage ethical performance
 |
| 1. Resource Implications
 |

|  |
| --- |
| The following resources should be provided:  |

* 1. Case studies/scenarios
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through: * Oral Interview
* Observation
* Third Party Reports
* Written
 |
| 1. Context of Assessment
 | * 1. Competency may be assessed in workplace or in a simulated workplace setting
	2. Assessment shall be observed while tasks are being undertaken whether individually or in-group
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEMONSTRATE ENVIRONMENTAL LITERACY

**UNIT CODE: COS/OS/HD/BC/06/6**

**UNIT DESCRIPTION**

This unit specifies the competencies required to follow procedures for environmental hazard control, follow procedures for environmental pollution control, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, develop and adhere to environmental protection principles/strategies/guidelines, analyze resource use, develop resource conservation plans and implement selected plans.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Control environmental hazard
 | 1.1 ***Storage methods*** for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS. 1.2 ***Disposal methods*** of hazardous wastes are followed at all times according to environmental regulations and OSHS.1.3 ***PPE*** is used according to OSHS.  |
| 1. Control environmental Pollution control
 | * 1. Environmental pollution ***control measures*** are compiled following standard protocol.
	2. Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999
	3. Methods for minimizing ***noise pollution*** complied following environmental regulations.
 |
| 1. Demonstrate sustainable resource use
 | * 1. Methods for minimizing wastage are complied with.
	2. Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle)
	3. Methods for economizing or reducing resource consumption are practiced.
 |
| 1. Evaluate current practices in relation to resource usage
 | * 1. Information on resource efficiency systems and procedures are collected and provided to the work group where appropriate.
	2. Current resource usage is measured and recorded by members of the work group.
	3. Current purchasing strategies are analyzed and recorded according to industry procedures.
	4. Current work processes to access information and data is analyzed following enterprise protocol.
 |
| 1. Identify Environmental legislations/conventions for environmental concerns
 | 5.1 Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact5.2 Industrial standard/environmental practices are described according to the different environmental concerns |
| 1. Implement specific environmental programs
 | 6.1 Programs/Activities are identified according to organizations policies and guidelines.6.2 Individual roles/responsibilities are determined and performed based on the activities identified.6.3 Problems/constraints encountered are resolved in accordance with organizations’ policies and guidelines6.4 Stakeholders are consulted based on company guidelines |
| 1. Monitor activities on Environmental protection/Programs
 | 7.1 Activities are periodically monitored and Evaluated according to the objectives of the environmental program7.2 Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations7.3 Data gathered are analyzed based on Evaluation requirements7.4 Recommendations are submitted based on the findings7.5 Management support systems are set/established to sustain and enhance the program7.6 Environmental incidents are monitored and reported to concerned/proper authorities |
| 1. Analyze resource use
 | 8.1. All resource consuming processes are Identified8.2. Quantity and nature of Resource consumed is determined8.3. Resource flow is analyzed through different parts of the process.8.4. Wastes are classified for possible source of resources. |
| 1. Develop resource Conservation plans
 | 9.1. Efficiency of use/conversion of resources is determined following industry protocol.9.2. Causes of low efficiency of use of resources are  Determined based on industry protocol.9.3. Plans for increasing the efficiency of resource use are developed based on findings. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| ***PPE*** May include but are not limited to | 1.1 Mask1.2 Gloves1.3 Goggles1.4 Safety hat1.5 Overall1.6 Hearing protector |
| ***Environmental pollution control measures*** may include but are not limited to: | 2.1 Methods for minimizing or stopping spread and ingestion of airborne particles2.2 Methods for minimizing or stopping spread and ingestion of gases and fumes2.4 Methods for minimizing or stopping spread and ingestion of liquid wastes |
| ***Wastes*** may include but are not limited to: | 3.1 Unnecessary waste3.2 Necessary waste |
| ***Waste management Procedures*** may include but are not limited to: | 4.1 Sorting4.2 Storing of items4.2 Recycling of items4.3 Disposal of items |
| ***Resources*** may include but are not limited to: | 5.1 Electric5.2 Water5.3 Fuel5.4 Telecommunications5.5 Supplies5.6 Materials |
| ***Workplace environmental hazards*** may include but are not limited to: | 6.1Biological hazards6.2 Chemical and dust hazards6.3 Physical hazards |
| ***Organizational systems and procedures*** may include but are not limited to: | 7.1 Supply chain, procurement and purchasing7.2 Quality assurance7.3 Making recommendations and seeking approvals |
| ***Legislations/Conventions*** may include but are not limited to: | 8.1 EMCA 19998.2 Montreal Protocol8.3 Kyoto Protocol |
| ***Environmental aspects/impacts*** may include but are not limited to: | 9.1 Air pollution9.2 Water pollution9.3 Noise pollution9.4 Solid waste9.5 Flood control9.6 Deforestation/Denudation9.7 Radiation/Nuclear /Radio Frequency/ Microwaves9.8 Situation9.9 Soil erosion (e.g. Quarrying, Mining, etc.)9.10 Coral reef/marine life protection |
| ***Industrial standards / Environmental practices*** may include but are not limited to: | 10.1 ISO standards10.2 Company environmental management systems (EMS) |
| ***Periodic*** may include but are not limited to: | 11.1 hourly11.2 daily11.3 weekly11.4 monthly11.5 quarterly11.6 yearly |
| ***Programs/Activities*** may include but are not limited to: | 12.1 Waste disposal (on-site and off-site)12.2 Repair and maintenance of equipment12.3 Treatment and disposal operations12.4 Clean-up activities12.5 Laboratory and analytical test12.6 Monitoring and evaluation12.7 Environmental advocacy programs |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Following storage methods of environmentally hazardous materials
* Following disposal methods of hazardous wastes
* Using PPE
* Practicing OSHS
* Complying environmental pollution control
* Observing solid waste management
* Complying methods of minimizing noise Pollution
* Complying methods of minimizing wastage
* Employing waste management procedures
* Economizing resource consumption
* Listing of resources used
* Measuring current usage of resources
* Identifying and reporting workplace environmental hazards
* Conveying all environmental issues
* Following environmental regulations
* Identifying environmental regulations
* Assessing procedures for assessing compliance
* Collecting information on environmental and resource efficiency systems and procedures, and Providing information to the work group
* Measuring and recording current resource usage
* Analysing and recording current purchasing strategies.
* Analysing current work processes to access information and data and Assisting identifying areas for improvement
* Analysing resource flow
* Determining efficiency of use/conversion of resources
* Determining causes of low efficiency of use
* Developing plans for increasing the efficiency of resource use
* Checking resource use plans
* Complying to regulations/licensing requirements
* Determining benefit/cost of plans
* Ranking proposals based on benefit/cost compared to limited resources
* Checking proposals meet regulatory requirements
* Monitoring implementation
* Making adjustments to plan and implementation
* checking new resource usage

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Storage methods of environmentally hazardous materials
* Disposal methods of hazardous wastes
* Usage of PPE Environmental regulations
* OSHS
* Types of pollution
* Environmental pollution control measures
* Different solid wastes
* Solid waste management
* Different noise pollution
* Methods of minimizing noise pollution
* Methods of minimizing wstage
* Waste management procedures
* Economizing of resource consumption
* Principle of 3Rs
* Types of resources
* Techniques in measuring current usage of resources
* Calculating current usage of resources
* Types of workplace environmental hazards
* Environmental regulations
* Environmental regulations applying to the enterprise.
* Procedures for assessing compliance with environmental regulations.
* 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 current work processes to access information and data Analysis of data and information
* Identification of areas for improvement
* Resource consuming processes
* Determination of quantity and nature of resource consumed
* Analysis of resource flow of different parts of the resource flow process
* Use/conversion of resources
* Causes of low efficiency of use
* Increasing the efficiency of resource use
* Inspection of resource use plans
* Regulations/licensing requirements
* Determine benefit/cost for alternative resource sources
* Benefit/costs for different alternatives
* Components of proposals
* Criteria on ranking proposals
* Regulatory requirements
* Proposals for improving resource efficiency
* Implementation of resource efficiency plans
* Procedures in monitor implementation
* Adjustments of implementation plan
* Inspection of new resource usage

**EVIDENCE GUIDE**

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

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

## DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE: COS/OS/HD/BC/07/6**

**UNIT DESCRIPTION**

This unit specifies the competencies required to lead the implementation of workplace’s safety and health program, procedures and policies/guidelines.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| 1. Identify workplace hazards and risk
 | 1.1 ***Hazards*** in the workplace and/or its ***indicators*** of its presence, are identified1.2 ***Evaluation and/or work environment*** measurements of OSH hazards/risk existing in the workplace is conducted by  Authorized personnel or agency1.3 ***OSH issues and/or concerns*** raised by workers are  Gathered |
| 1. Identify and implement appropriate control measures
 | 2.1 Prevention ***and control measures***, including use of  s***afety gears / PPE (personal protective equipment)*** for specific hazards  identified and implemented2.2 ***Appropriate risk controls*** based on result of OSH hazard evaluation is recommended.2.3 ***Contingency measures***, including ***emergency procedures*** during workplace ***incidents and emergencies*** are recognized and established in accordance with organization procedures. |
| 1. Implement OSH programs, procedures and policies/ guidelines
 | 3.1 Information to work team about company OSH program, procedures and policies/guidelines are provided3.2 Implementation of OSH procedures and policies/ guidelines are participated3.3 Team members are trained and advised on OSH standards and procedures3.4 Procedures for maintaining ***OSH-related records*** are implemented |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. ***Hazards may include*** but are not limited to:
 | 1.1. Physical hazards – impact, illumination, pressure, noise, vibration, extreme temperature, radiation1.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects1.3 Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors1.4 Ergonomics Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles Physiological factors – monotony, personal relationship, work out cycle1.6 Safety hazards (unsafe workplace condition) – confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris1.7 Unsafe workers’ act (Smoking in off-limited areas, Substance and alcohol abuse at work) |
| 1. ***Indicators may include*** but are not limited to:
 | 2.1 Increased of incidents of accidents, injuries2.2 Increased occurrence of sickness or health complaints/ symptoms2.3 Common complaints of workers related to OSH2.4 High absenteeism for work-related reasons |
| 1. ***Evaluation and/or work environment measurements*** may include but are not limited to:
 | 3.1 Health Audit3.2 Safety Audit3.3 Work Safety and Health Evaluation3.4 Work Environment Measurements of Physical and Chemical  Hazards |
| 1. ***OSH issues and/or concerns*** may include but are not limited to:
 | 4.1 Workers’ experience/observance on presence of work hazards4.2 Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks)4.3 Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines |
| 1. ***Prevention and control measures*** may include but are not limited to:
 | 5.1 Eliminate the hazard (i.e., get rid of the dangerous machine5.2 Isolate the hazard (i.e. keep the machine in a closed room and operate it remotely; barricade an unsafe area off) 5.3 Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one)5.4 Use administrative controls to reduce the risk (i.e. give trainings on how to use equipment safely; OSH-related topics, issue warning signages, rotation/shifting work schedule)5.5 Use engineering controls to reduce the risk (i.e. use safety guards to machine)5.6 Use personal protective equipment5.7 Safety, Health and Work Environment Evaluation5.8 Periodic and/or special medical examinations of workers |
| 1. ***Safety gears /PPE (Personal Protective Equipment)*** may include but are not limited to:
 | 6.1 Arm/Hand guard, gloves6.2 Eye protection (goggles, shield)6.3 Hearing protection (ear muffs, ear plugs)6.4 Hair Net/cap/bonnet6.5 Hard hat6.6 Face protection (mask, shield)6.7 Apron/Gown/coverall/jump suit6.8 Anti-static suits* 1. High-visibility reflective vest
 |
| 1. ***Appropriate risk controls***
 | Appropriate risk controls in order of impact are as follows:7.1 Eliminate the hazard altogether (i.e., get rid of the dangerous machine)7.2 Isolate the hazard from anyone who could be harmed (i.e., keep the machine in a closed room and operate it remotely; barricade an unsafe area off)7.3 Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one)7.4 Use administrative controls to reduce the risk (i.e., train workers how to use equipment safely; train workers about the risks of harassment; issue signage)7.5 Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users)7.6 Use personal protective equipment (i.e., wear gloves and goggles when using the machine) |
| 1. ***Contingency measures*** may include but are not limited to:
 | 8.1 Evacuation8.2 Isolation8.3 Decontamination8.4 (Calling designed) emergency personnel |
| 1. ***Emergency procedures*** may include but are not limited to:
 | 9.1 Fire drill9.2 Earthquake drill9.3 Basic life support/CPR9.4 First aid9.5 Spillage control9.6 Decontamination of chemical and toxic9.7 Disaster preparedness/management9.8 se of fire-extinguisher |
| 1. ***Incidents and emergencies*** may include but are not limited to:
 | 10.1 Chemical spills10.2 Equipment/vehicle accidents10.3 Explosion10.4 Fire10.5 Gas leak10.6 Injury to personnel10.7 Structural collapse10.8 Toxic and/or flammable vapors emission. |
| 1. ***OSH-related Records*** may include but are not limited to:
 | 11.1 Medical/Health records11.2 Incident/accident reports11.3 Sickness notifications/sick leave application11.4 OSH-related trainings obtained |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Skills on preliminary identification of workplace hazards/risks
* Knowledge management
* Critical thinking skills
* Observation skills
* Coordinating skills
* Communication skills
* Interpersonal skills
* Troubleshooting skills
* Presentation skills
* Training skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:1. Identifies hazards/risks in the workplace and/or its indicators
2. Requests for evaluation and/or work environment measurements of OSH hazards/risk in the workplace
3. Gathers OSH issues and/or concerns raised by workers
4. Identifies and implements prevention and control measures, including use of PPE (personal protective equipment) for specific hazards
5. Recommends appropriate risk controls based on result of OSH hazard evaluation and OSH issues gathered
6. Establish contingency measures, including emergency procedures in accordance with organization procedures
7. Provides information to work team about company OSH program, procedures and policies/guidelines
8. Participates in the implementation of OSH procedures and policies/guidelines
9. Trains and advises team members on OSH standards and procedures
10. Implements procedures for maintaining OSH-related records
 |
| 1. Resource Implications
 | The following resources should be provided:2.1 Workplace or assessment location2.2 OSH personal records2.3 PPE2.4 Health records |
| 1. Methods of Assessment
 | Competency may be assessed through:3.1 Portfolio Assessment3.2 Interview3.3 Case Study/Situation3.4 Observation/Demonstration and oral questioning |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# COMMON UNITS

## APPLY PHYSICS PRINCIPLES

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

**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

This standard applies in analytical chemistry sector.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENTS**These describe the **key outcomes** which make up **workplace function.** | **PERFORMANCE CRITERIA**These are **assessable** statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| 1. Apply units of measurement and measuring instruments.
 | * 1. ***Basic quantities and derived* quantities** are identified based on the SI units
	2. Interconversion of units is performed in accordance with appropriate systems of measurement
	3. Dimensional analysis is performed in accordance to units of measurement
	4. Measurements are performed using suitable **instruments** in accordance with appropriate units
 |
| 1. Apply the principles of forces
 | * 1. ***Types of forces*** and their effects are identified in accordance to work place tasks
	2. Moment of a force and its SI unit is determined in accordance with work place tasks
	3. Forces are resolved in accordance with workplace tasks
	4. Resultant forces are determined as per reference
	5. The principle of moments is applied to solve problems as per reference
	6. Centre of gravity of objects is determined in accordance to moments
	7. Laws of friction are applied as per reference
	8. Effects of friction are identified based on experiments
	9. Benefits of reducing friction are described as applied to maintaining machines
	10. Tools and equipment are operated based on standard operating procedures (SOPs)
 |
| 1. Solve problems related to motion, work energy and power
 | * 1. Laws of linear ***motion*** are applied as per reference
	2. Parameters of motion are calculated based on the laws of motion.
	3. Force formula is derived in accordance with laws of motion
	4. Motion under gravity is determined in accordance to the laws of motion
	5. Motion graphs are drawn based on parameters of motion.
	6. Forms of energy and energy transformations are identified based on reference
	7. Sources of energy are identified based on the forms of energy
	8. Problems on Work, energy and power are solved based on standard formulas.
 |
| 1. Apply the concepts of density and pressure
 | * 1. Laws and principles appropriate to fluid pressure are applied in accordance with reference
	2. Atmospheric and fluid pressures are determined using pressure simple gauging instruments. .
 |
| 1. Apply the principles of fluid flow and heat transfer
 | * 1. Streamline and turbulent flow are compared through demonstration
	2. Bernoulli’s effect and equation of continuity are determined as applied pressure, speed, and height (y) at two points in a steady-flowing, non-viscous, incompressible fluid.
	3. Modes of heat transfer are identified based on the type of material
	4. Heat transfer is applied based on the modes
	5. Thermal expansion is identified based on the type of materials
	6. Thermal expansion is applied based on the type of materials
 |
| 1. Apply properties of light and sound waves
 | * 1. Laws of reflection and refraction are applied to determine distance, size objects and refractive indices based on the type of material
	2. Properties of waves are applied based on the effects of resonance to structures
	3. Propagation of sound is applied to perform calculations based on relation amplitude, wavelength, frequency, and distance analyzed
 |

**RANGE**

This section provides work environment and conditions to which the performance

Criteria apply. It allows for different work environment and situations that will affect

Performance.

|  |  |
| --- | --- |
| **Variable** | **Range**may include but is not limited to: |
| Units of concentration may include but is not limited to: | * Molarity
* Molality
* equivalent weight
* Normality,
* Percentage (by mass, by volume)
* Mass/mass (e.eg. g/g, mg/kg)
* Mass/volume (e.g. mg/l)
* Parts (ppm, ppb, ppt)
 |
| Basic units of measurements may include but is not limited to: | * Mass
* Length
* Time
 |
| Derived units of measurements may include but is not limited to: | * Velocity
* acceleration
* force
* volume
* discharge
* pressure
* viscosity (kinematic & dynamic)
* surface tension
* specific weight
* capillarity
* torque
* work
* energy
* power
* density
* compressibility
 |
| Measuring instruments may include but is not limited to: | * meter rule
* tape measure
* beam balance
* stop clock/watch
* measuring cylinder
* pipette
* burette
* Micrometer screw gauge
* Vernier calipers
 |
| Errors in measurements may include but is not limited to: | * Parallax
* Zero error
* Misreading errors
 |
| Types of forces may include but is not limited to: | * Cohesive and adhesive
* Surface tension
* Up thrust force
* Tension
* Gravitational force
* Mechanical force
* Electrostatic force
* Magnetic force
* Centripetal force
* Centrifugal forces
 |
| Motion may include but is not limited to: | * Linear motion
* Circular motion
* Projectile motion
 |
| Terms used in motion may include but is not limited to: | * Distance
* Displacement
* Speed
* Velocity
* Acceleration
* Angular displacement
* Angular velocity
* Frequency
* Period
 |
| Terms in fluid flow may include but is not limited to: | * Viscosity
* Streamline flow
* Turbulent flow
* Line of flow
* Laminar flow
* Tube of flow
 |
| Terms used in waves may include but is not limited to: | * Waves
* Amplitude
* Loudness
* Pitch
* Period
* Frequency
* Intensity of sound
* Resonance
 |
| Terms used in heat may include but is not limited to: | * Conduction
* Convection
* Radiation
* Bimetallic strips
* Rivets
* Analogous behavior
 |

## APPLY STANDARD LABORATORY PRACTICES

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

**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.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| * 1. Identify and manage laboratory hazards and risks
 | * 1. ***Sources of laboratory hazards and risks*** are identified based on laboratory safety requirements
	2. Poisonous and dangerous chemicals are labelled clearly as per the laboratory procedures
	3. ***Laboratory safety*** procedures are developed according to medical laboratory standards
	4. ***Laboratory hazards*** are handled in accordance with safety procedures
	5. Biological samples are stored according to medical laboratory protocols
	6. Types of injuries and their treatment are identified and determined according to standard laboratory safety
	7. Types of poisons are identified, and their treatment determined based on safety standards
 |
| * 1. Apply laboratory safety procedures
 | * 1. ***Harmful chemicals*** are identified, labelled and handled according to laboratory safety requirements
	2. Exits in case of fire or emergency are labelled as per the workplace and safety procedures.
	3. First aid kits are stocked and placed strategically as per safety procedures
	4. Brocken glasses are disposed as per workplace and safety procedures
	5. Fire fighting equipment are fitted strategically and regularly maintained as per manufacturer’s instructions
	6. First aid procedures are reviewed and updated periodically according to safety guidelines
 |
| * 1. Store laboratory samples
 | * 1.
 |
| * 1. Prepare laboratory reagents
 | * 1. ***Laboratory reagents*** are determined according to laboratory tests and standard procedures
	2. ***Methods of preparation*** are identified and applied based on standard procedures
	3. Personal protective equipment is selected and used as per laboratory safety requirements
	4. Laboratory reagents and chemicals are labelled a per the workplace procedures
 |
| * 1. Store chemicals and reagents
 | * 1. Stores and cabinets are labelled as per stored items and workplace procedures
	2. Chemicals and reagents bottles are labelled as per the content and characteristics
	3. Perform frequent stock taking as per work place procedures
 |
| * 1. Dispose laboratory wastes
 | * 1. Laboratory waste is separated as per the type, category and characteristics
	2. The method of waste disposal is determined as per the waste type
	3. Laboratory waste is disposed as per the type of waste
 |
| * 1. Maintain laboratory ware and equipment
 | * 1. ***Laboratory ware and equipment*** are identified based on laboratory analysis requirements
	2. ***Preparation of laboratory ware*** is carried out based on standard manuals requirements
	3. Preventive ***maintenance*** of laboratory equipment is undertaken according to standard procedures
	4. ***Operation of instruments*** is undertaken according to standard manual procedures
 |
| * 1. Maintain laboratory hygiene
 | * 1. Laboratory disinfectants and antiseptics are prepared based on SOPs
	2. Laboratory working areas, benches and equipment are routinely decontaminated and cleaned according to set laboratory procedures
	3. Laboratory wastes are segregated and disposed as per standard procedures
	4. Laboratory records are kept and maintained according to standard laboratory procedures
 |
| * 1. Specify analytical equipment for procurement
 | * 1. The analytical equipment identified as per the workplace procedures
	2. The specifications of the equipment are identified as per the requirements
	3. A requisition is prepared as per the workplace procedures
 |
| * 1. Receive and commission analytical equipment
 | * 1. The specification requirements are confirmed as per the workplace procedures
	2. The equipment is received as pee the workplace procedures
	3. The received equipment is inventoried as per the workplace procedures
	4. The commissioning/installation of the equipment is coordinated as per the workplace procedures
	5. End user Training is coordinated as per the workplace procedures
 |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| l***aboratory*** ***hazards*** and risks may include but not limited to: | * Cutting glass tubes and rod
* Heating
* Carrying
* Boring corks
* Broken glass
* Glassware for vacuum and pressure work
* Bending
 |
| ***Laboratory safety*** may include but not limited to: | * PPE
* Proper handling
* Use of cork borers
* Proper choice of glass
* Flame polishing
* Acid dilution procedures
* Laboratory rules
* Regular checks of regulating devices, gauges and valves
* Proper storage of chemicals
* Precautions against naked flames
* Fire fighting materials and equipment
* Proper handling of potentially explosive chemicals
* Proper storage of radioactive materials
* Proper wiring
* Good housekeeping
	+ General cleanliness
	+ Personal cleanliness
* Avoidance of eating, running and smoking
 |
| ***Laboratory hazards*** may include but not limited to:  | * Chemical
	+ Corrosiveness
	+ Carcinogens
	+ Inflammable
	+ Fuming
	+ Poisons
	+ Explosives
* Biological hazards
	+ Microbes
	+ Poisonous plants
	+ Poisonous animals
 |
| ***Laboratory ware*** and equipment may include but not limited to: | * Glass slides
* Test tubes
* Microscope
* Microtome
* Centrifuge
* Autoclave
* Vacutainer tubes
* Needles and syringes
* Safety devices
* Automated analysers
* Refrigerators
* Freezers
* Incubators
 |
| ***maintenance*** may include but not limited to: | * Cleaning
	+ Dusting
	+ Wiping
* Lubrication
* Storage
* Oiling and greasing
 |
| ***Operation of instruments*** may include but not limited to: | * Calibration
* Use/handling
* Maintenance
* Cleaning
 |
| Laboratory reagents may include but not limited to: | * Formalin
* Formal saline
* Stains
* Acid alcohols
* Dehydrants
* Fixatives
* Mountants
 |
| Methods of preparation may include but not limited to: | * Dilution
* Titration
* Reconstitution
* Heating
 |
| ***Harmful chemicals*** may include but not limited to: | * Acids
* Explosives
* Carcinogens
* Poisons
* Fumes
* Irritants
* Corrosives
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Troubleshooting
* Analytical
* Reporting
* First aid
* Communication
* Critical thinking
* Problem solving

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Laboratory ware and equipment maintenance
* Quantitative and qualitative analysis
* Laboratory safety designs
* Laboratory waste disposal
* Laboratory ethical standards
* Good laboratory practices
* Record maintenance
* Laboratory hygiene

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Identified sources of laboratory hazards
	2. Developed laboratory safety procedures
	3. Operated analytical laboratory equipment accordingly
	4. Prepared, used and stored laboratory reagents and chemicals appropriately
	5. Maintained laboratory hygiene
	6. Maintained laboratory safety design features
	7. Demonstrated understanding of occupational safety and health practices (OSHA)
 |
| 1. Resource Implications
 | The following resources should be provided:* 1. Well-equipped functional laboratory facility
	2. Standard laboratory procedures
	3. Laboratory ware and equipment
	4. Computer
 |
| 1. Methods of Assessment
 | Competency in this unit may be assessed through:1. Oral
2. Written
3. Observation
4. Third party
5. Case study
 |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY INORGANIC CHEMISTRY

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

**UNIT DESCRIPTION:**

This unit describes the competencies required by a technician in order to Demonstrate knowledge of periodic table, Demonstrate the knowledge of chemical bonding, demonstrate knowledge of chemical equations, demonstrate knowledge of chemical reactions and Demonstrate knowledge on qualitative and quantitative analysis of inorganic compound

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| * + 1. Demonstrate knowledge of periodic table
 | * 1. Chemical symbols of ***elements*** are written as per the IUPAC nomenclature
	2. ***Groups and periods*** of elements are identified as per the procedures
	3. Knowledge about the trends across the period and down the group should be demonstrated as per the atomic size
	4. Metals and non-metals are identified as per the group and period they belong in the periodic table
	5. Knowledge of writing of ***electronic configuration*** of elements is demonstrated as per the procedures
	6. Knowledge of ***orbitals and suborbital*** for elements above atomic number 20 are demonstrated as per the procedures
	7. Knowledge of energies states at each energy level, orbital and sub orbitals is demonstrated as per the procedures
	8. Knowledge of classification of elements in 1s, 2s, 2p, 3s, 3p, 4s, and 3d blocks is demonstrated as per the orbitals
	9. Knowledge of writing the electronic configuration of elements using the ***spdf blocks*** is demonstrated as per the energy levels.
 |
| * + 1. Demonstrate the knowledge of chemical bonding and structures
 | * 1. Knowledge of types of ***chemical*** ***bonds*** is demonstrated as per the bonding atoms
	2. Types of bond are identified as per the bonding atoms
	3. Knowledge of formulae of compounds is demonstrated as per the valences of reacting elements.
	4. Chemical bonds are drawn as per the structures
	5. Knowledge of properties of chemical bonds is demonstrated as per the chemical bond
	6. Knowledge of formation of chemical structures form chemical bond is demonstrated as per the
	7. Knowledge of types of chemical structures is demonstrated as per the types of bonds used
	8. Demonstrate knowledge of chemical and physical properties of chemical structures as per the bonding type
	9. Knowledge of chemical bonds and structures is applied in compounds as per the elements present
	10. Knowledge of crystal structures as per the compound type
 |
| * + 1. Demonstrate knowledge of chemical equations
 | * 1. Chemical equations are written as per reacting elements and product formed
	2. Chemical equations are balanced as per the procedure
 |
| * + 1. Demonstrate knowledge on qualitative and quantitative analysis of inorganic compound
 | * 1. Demonstrate knowledge of flame test in determining the identity of the elements or compound as per standards
	2. Demonstrate knowledge of flame photometry as per the set standard
	3. Demonstrate knowledge emission and absorption as per the set standard
	4. Demonstrate knowledge test for anions and cations as per the procedure
	5. Demonstrate knowledge of use of ***pH*** to test for the basicity or acidity of a solution
	6. Demonstrate knowledge for test for identity of gases as per the procedure
 |
| * + 1. Demonstrate knowledge of nuclear chemistry
 | * 1. Demonstrate knowledge of radioactive materials as per the procedure
	2. Calculations involving half-life is performed as per the procedure
	3. Demonstrate knowledge of radioactive reactions and radiation particles as per the reactions
	4. Radioactive equations are balanced as per the procedure
	5. Demonstrate knowledge nuclear stability and binding energy
	6. Demonstrate knowledge of applications of radio activity
	7. Demonstrate knowledge tests for radio activity or radioactive materials
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable**  | **Range** *May include but not limited to:* |
| * 1. ***Elements***
 | 1. Hydrogen
2. Oxygen
3. Sulphur etc.
 |
| * 1. ***Groups and periods***
 | Groups and periods as they appear in the periodic table  |
| * 1. ***electronic configuration***
 | Arrangements of electrons of an atom/molecule in the atomic or molecular orbitals  |
| * 1. ***orbitals and suborbital***
 | 1. regions around the nucleus in an atom or a molecule
 |
| * 1. ***spdf blocks***
 | 1. energy levels that hold electrons in atoms

s-blockp-blockd-blockf-block |
| * 1. ***chemical*** ***bonds***
 | 1. covalent
2. ionic
3. metallic
4. polar
5. hydrogen
 |
| * 1. ***pH***
 | 1. potential hydrogens
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Logical thinking
* Problem solving
* Communication skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Atomicity and periodicity
* Structure and bonding
* Balancing of chemical equations
* Reaction mechanisms
* Qualitative and quantitative analysis
* Radio activity

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + 1. Critical aspects of Competency
 | **Assessment requires evidence that the candidate:** * 1. Knowledge of writing of ***electronic configuration*** of elements is demonstrated as per the procedures
	2. Knowledge of classification of elements in 1s, 2s, 2p, 3s, 3p, 4s, and 3d blocks is demonstrated as per the orbitals
	3. Knowledge of writing the electronic configuration of elements using the ***spdf blocks*** is demonstrated as per the energy levels.
	4. Chemical bonds are drawn as per the structures
	5. Demonstrate knowledge of chemical and physical properties of chemical structures as per the bonding type
	6. Knowledge of chemical bonds and structures is applied in compounds as per the elements present
	7. Chemical equations are balanced as per the procedure
	8. Demonstrate knowledge of flame test in determining the identity of the elements or compound as per standards
	9. Demonstrate knowledge test for anions and cations as per the procedure
	10. Calculations involving half-life is performed as per the procedure
	11. Radioactive equations are balanced as per the procedure
	12. Demonstrate knowledge tests for radio activity or radioactive materials
 |
| * + 1. Resource Implications
 | The following resources should be provided: * Access to relevant workplace or appropriately simulated environment where assessment can take place
* Laboratory and its fixtures
* Stationary
* Reagents/ chemicals
* Period table
* pH scale
* models
* GM tube
 |
| * + 1. Methods of Assessment
 | Competency in this unit may be assessed through: * Direct Observation
* Demonstration with Oral Questioning
* Written tests
 |
| * + 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through accredited institution  |
| * + 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY PHYSICAL CHEMISTRY

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

**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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Demonstrate the knowledge of gas behaviour
 | * 1. knowledge of the ***states of matter*** is demonstrated as per set standards
	2. Knowledge of ***gas laws*** is demonstrated as per set standards
	3. Knowledge of kinetic theory is demonstrated as the kinetic gas equation
	4. Knowledge of behaviour of real gases is demonstrated as per van der Waals equation
	5. Knowledge of heat capacities at constant pressure and constant volume is demonstrated as per set standards
 |
| 1. Demonstrate knowledge of chemical reactions
 | * 1. Knowledge of reversible and irreversible is demonstrated as per the type of reactions
	2. Knowledge of equilibrium is demonstrated as per the reaction type
	3. ***Equilibrium constant*** is calculated as per the procedures
	4. Knowledge of Le chatelier’s principle is demonstrate as per the reaction type.
	5. ***Application of Le chatelier’s principle*** is demonstrated as per the chemical process
 |
| 1. Demonstrate the knowledge of phase diagrams
 | * 1. Knowledge phase rule is demonstrated as per Gibbs equation
	2. Knowledge of phase equilibrium diagrams
	3. Knowledge of features and characteristics of allotropes is demonstrated
	4. Knowledge of eutectic mixtures as demonstrated by two component systems
	5. Knowledge of vapour pressure of ideal solutions is demonstrated as per Raoults law and composition diagrams
	6. Knowledge of steam distillation is demonstrated as per solubility of liquids
	7. Knowledge of solubility of gases is demonstrated as per Henrys law
 |
| 1. Demonstrate the knowledge of thermodynamics
 | * 1. Knowledge of systems is demonstrated as per the types
	2. Knowledge of the ***laws of thermodynamics*** are demonstrated as per the set standards
	3. Knowledge of entropy and free energy is demonstrated as per the laws of thermodynamics
	4. Knowledge of expansion of gases when work is done is demonstrated as per the procedures
	5. Knowledge of bond dissociation energies is demonstrated as per Hess’s law
	6. Calculation involving enthalpy changes are performed as per procedure
 |
| 1. Demonstrate the knowledge of Rate reactions
 | * 1. knowledge of ***order of reaction*** is demonstrated as per the rate equation
	2. Knowledge of variation of reaction rate with time is demonstrated as per the set standards
	3. Knowledge of half-life of reactions is demonstrated as per the reaction type
	4. Knowledge of activation energy is demonstrated as per Arrhenius equation
	5. Knowledge of collision theory of gases is demonstrated as per the set standards
	6. Knowledge of Maxwell distribution of kinetic energy is demonstrated as per the set standards
	7. Knowledge of catalyst, inhibitors and enzymes is demonstrated as per application industrial processes
	8. Knowledge of chain reaction is demonstrated as per the photochemical activation
 |
| 1. Demonstrate the knowledge of Electrochemistry
 | * 1. Knowledge of effect of electricity is demonstrated as per the set standards
	2. Measurement of conductivity of electrolytes is performed as per set standards
	3. Knowledge of variation of conductivity with temperature and concentration is demonstrated as per the set procedures
	4. Knowledge of conductimetric titrations is demonstrated as per the set procedures
	5. Knowledge of Kohlrausch’s law Ostwald’s dilution law is demonstrated as per the set standards
	6. Knowledge of is demonstrated as per the set procedures
	7. Knowledge of electrochemical cells and redox reactions is demonstrated as per the set standards
	8. Knowledge of electrode potential and EMF of a cell is demonstrated as per the set standards
	9. Knowledge of standard electrodes and measurement of pH is demonstrated as per the set standards
	10. Knowledge of Nernst equation is demonstrated as per the set standards
	11. Knowledge of polarisation and polagraphy and voltammetry is demonstrated as per the set standards
 |
| 1. Demonstrate the knowledge of thermometric analysis
 | * 1. Knowledge of effect of temperature on a substance is demonstrated as per the set standards.
	2. Knowledge of Freezing points determination is demonstrated as per the set standards
	3. Knowledge of Exothermic and endothermic reaction is demonstrated as per the set standards
	4. Knowledge of Thermometric titrations is demonstrated as per the set standards
 |

**RANGE**

This section provides work environment and conditions to which the performance

Criteria apply. It allows for different work environment and situations that will affect

Performance.

| **Variable** | **Range*****May include but is not limited to:*** |
| --- | --- |
| 1. ***states of matter***
 | * solids
* liquid
* gas
 |
| 1. ***gas laws***
 | * Boyle’s law
* Charles’s law
* Avogadro’s law
* Grahams law of diffusion
 |
| 1. ***Equilibrium constant***
 | * Ka
* Kp
* Kc
* Kb
 |
| 1. ***Application of Le chatelier’s principle***
 | * Haber process
* Contact process
 |
| 1. ***laws of thermodynamics***
 | * 1st law
* 2nd law
 |
| 1. ***phase equilibrium diagrams***
 | * sulphur
* water
* phosphorous
 |
| 1. ***order of reaction***
 | * zero order
* 1st order
* 2nd order
 |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

**Required Skills**

The individual needs to demonstrate the following skills:

* Logical thinking
* Problem solving
* Communication skills

**REQUIRED KNOWLEDGE**

* phase diagrams
* Thermodynamics
* Rate reactions
* Electrochemistry,
* thermometric analysis

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | **Assessment requires evidence that the candidate:*** 1. Knowledge of ***gas laws*** is demonstrated as per set standards
	2. Knowledge of behaviour of real gases is demonstrated as per van der Waals equation
	3. Equilibrium constant is calculated as per the procedures
	4. Knowledge of Le chatelier’s principle is demonstrate as per the reaction type.
	5. Application of Le chatelier’s principle is demonstrated as per the chemical process
	6. Knowledge of phase equilibrium diagrams
	7. Knowledge of vapour pressure of ideal solutions is demonstrated as per Raoults law and composition diagrams
	8. Knowledge of the laws of thermodynamics are demonstrated as per the set standards
	9. Calculation involving enthalpy changes are performed as per procedure
	10. knowledge of half-life of reactions is demonstrated as per the reaction type
	11. knowledge of activation energy is demonstrated as per Arrhenius equation
	12. knowledge of Maxwell distribution of kinetic energy is demonstrated as per the set standards
	13. Measurement of conductivity of electrolytes is performed as per set standards
	14. knowledge of conductimetric titrations is demonstrated as per the set procedures
	15. knowledge of Kohlrausch’s law Ostwald’s dilution law is demonstrated as per the set standards
	16. knowledge of electrode potential and EMF of a cell is demonstrated as per the set standards
	17. knowledge of polarisation and polarography and voltammetry is demonstrated as per the set standards
 |
| 1. Resource Implications
 | ***The following resources must be provided:***1. Access to relevant workplace or appropriately simulated environment where assessment can take place
2. Computer
3. Functional laboratory
4. Reagents and chemicals
5. Stationary
6. Library books
 |
| 1. Methods of Assessment
 | **Competency may be assessed through:*** 1. Oral questioning
	2. Practical demonstration
	3. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through a simulated work place environment |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ORGANIC CHEMISTRY

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

**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 techniquesDemonstrate knowledge of stereochemistry and Demonstrating knowledge of formulation chemistry

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| * + - 1. Demonstrate the knowledge of hydrocarbons

  | * 1. Knowledge of types of ***hydrocarbons*** is demonstrated as per set standards
	2. Knowledge of naming of hydrocarbons is demonstrated as per IUPAC system
	3. Knowledge of occurrence and laboratory preparation is demonstrated as per set procedures
	4. Knowledge of ***physical properties*** of hydrocarbons is demonstrated as per set procedures
	5. Knowledge of reaction and reaction mechanism of hydrocarbons is demonstrated as per set procedures
	6. Knowledge of structural isomerism of hydrocarbons is demonstrated as per set procedures
	7. Knowledge of uses of hydrocarbons is demonstrated as per set procedures
 |
| * + - 1. Demonstrate the knowledge of haloalkanes
 | * 1. Knowledge of classification and naming of haloalkanes is demonstrated as per set procedures
	2. Knowledge of preparation of haloalkanes is demonstrated as per set procedures
	3. Knowledge of physical properties of haloalkanes is demonstrated as per set procedures
	4. Knowledge of reactions and reaction mechanism of haloalkanes is demonstrated as per set procedures
	5. Knowledge of uses of haloalkanes is demonstrated as per set procedures
 |
| * + - 1. Demonstrate the knowledge of hydroxyl compounds
 | * 1. Knowledge of classification and naming of hydroxyl compounds is demonstrated as per set procedures
	2. Knowledge of preparation of hydroxyl compounds is demonstrated as per set procedures
	3. Knowledge of physical properties of hydroxyl compounds is demonstrated as per set procedures
	4. Knowledge of reactions and reaction mechanism of hydroxyl compounds is demonstrated as per set procedures
	5. Knowledge of uses of hydroxyl compounds is demonstrated as per set procedures
 |
| * + - 1. Demonstrate the knowledge of carbonyl compounds
 | * 1. Knowledge of classification and naming of carbonyl compounds is demonstrated as per set procedures
	2. Knowledge of preparation of carbonyl compounds is demonstrated as per set procedures
	3. Knowledge of physical properties of carbonyl compounds is demonstrated as per set procedures
	4. Knowledge of reactions and reaction mechanism of carbonyl compounds is demonstrated as per set procedures
	5. Knowledge of uses of carbonyl compounds is demonstrated as per set procedures
 |
| * + - 1. Demonstrate knowledge of carboxylic acids
 | * 1. Knowledge of naming of carboxylic acids is demonstrated as per IUPAC system
	2. Knowledge of preparation of carboxylic acids is demonstrated as per set procedures
	3. Knowledge of physical properties of carboxylic acids is demonstrated as per set procedures
	4. Knowledge of reactions and reaction mechanism of carboxylic acids is demonstrated as per set procedures
	5. Knowledge of uses of carboxylic acids is demonstrated as per set procedures
 |
| * + - 1. Demonstrate knowledge of carboxylic acid derivatives
 | * 1. Knowledge of naming of ***carboxylic acid derivatives*** is demonstrated as per IUPAC system
	2. Knowledge of preparation of carboxylic acid derivatives is demonstrated as per set procedures
	3. Knowledge of physical properties of carboxylic acid derivatives is demonstrated as per set procedures
	4. Knowledge of reactions and reaction mechanism of carboxylic acid derivatives is demonstrated as per set procedures
	5. Knowledge of uses of carboxylic acid derivatives is demonstrated as per set procedures
 |
| * + - 1. Demonstrate knowledge of amines and nitrogen compounds
 | * 1. Knowledge of classification and naming of amines and ***nitrogen compounds*** is demonstrated as per set procedures
	2. Knowledge of preparation of amines and nitrogen compounds is demonstrated as per set procedures
	3. Knowledge of physical properties of amines and nitrogen compounds is demonstrated as per set procedures
	4. Knowledge of reactions and reaction mechanism of amines and nitrogen compounds is demonstrated as per set procedures
	5. Knowledge of uses of amines and nitrogen compounds is demonstrated as per set procedures
 |
| * + - 1. Demonstrate the knowledge of aromatic compounds
 | * 1. Knowledge of definition of aromatic compound is demonstrated as per set standards
	2. Knowledge of Kekule structures of benzene is demonstrated as per set standards
	3. Knowledge of naming of benzene and derivatives is demonstrated as per set standards
	4. Knowledge of electrophilic and nucleophilic substitution reactions and reaction mechanism of benzene is demonstrated as per set procedures
	5. Knowledge of electrophilic and nucleophilic substitution reactions and reaction mechanism of substituted benzene is demonstrated as per set procedures
	6. Knowledge of oxidation of benzene is demonstrated as per set procedures
 |
| * + - 1. Demonstrate the knowledge of heterocyclic compounds
 | * 1. Knowledge of definition of heterocyclic compound is demonstrated as per set standards
	2. Knowledge of structures of heterocyclic compounds is demonstrated as per set standards
	3. Knowledge of naming and ***classification of heterocyclic compounds*** is demonstrated as per set standards
	4. Knowledge of substitution reactions of heterocyclic compounds is demonstrated as per set procedures
	5. Knowledge of naturally occurring heterocyclic compounds is demonstrated as per set procedures
	6. Knowledge of uses of heterocyclic compounds is demonstrated as per set procedures
 |
| * + - 1. Demonstrate the knowledge of polynuclear aromatic compounds
 | * 1. Knowledge of definition of polynuclear aromatic compound is demonstrated as per set standards
	2. Knowledge of naming and structure of polynuclear aromatic compounds is demonstrated as per set standards
	3. Knowledge of reactions of polynuclear aromatic compounds is demonstrated as per set procedures
	4. Knowledge of synthesis of polynuclear aromatic compounds is demonstrated as per set procedures
	5. Knowledge of uses of polynuclear aromatic compounds is demonstrated as per set standards
 |
| * + - 1. Demonstrate knowledge of polymer chemistry
 | * 1. Knowledge of definition of polymers is demonstrated as per set standards
	2. Knowledge of naming and classification of polymers is demonstrated as per set standards
	3. Knowledge of polymerisation reactions of polymers is demonstrated as per set procedures
	4. Knowledge of uses of polymers is demonstrated as per set procedures
 |
| * + - 1. Demonstrate knowledge of stereochemistry
 | * 1. knowledge of definition in stereochemistry is demonstrated as per the standards
	2. knowledge of stereo isomerism is demonstrated as per the set standard
	3. knowledge of optical activity is demonstrated as per the set standard
 |
| * + - 1. Demonstrate knowledge on organic spectroscopic techniques
 | * 1. Knowledge of the theory of molecular vibration is demonstrated
	2. Knowledge of factor affecting molecular vibration is demonstrated
	3. Knowledge of theory of molecular absorption is demonstrated
	4. Knowledge of components of infra-red, UV visible and NMR spectrophotometer is demonstrated
	5. Knowledge of sampling and sample preparation is demonstrated
	6. Knowledge of application of molecular spectroscopy is demonstrated
 |
| * + - 1. Demonstrate knowledge of formulation chemistry
 | * 1. Knowledge of formulation adhesives is demonstrated as per the set standard
	2. Knowledge of formulation paints is demonstrated as per the set standards
	3. Knowledge of Cosmetics is demonstrated as per the set standard
	4. Knowledge of Detergents is demonstrated as per the set standard
	5. Knowledge of Inks is demonstrated as per the set standard
	6. Knowledge of Pharmaceutical productsis demonstrated as per the set standard
 |

**RANGE**

This section provides work environment and conditions to which the performance

Criteria apply. It allows for different work environment and situations that will affect

Performance.

| **Variable** | **Range*****May include but is not limited to:*** |
| --- | --- |
| 1. ***Hydrocarbons***
 | * Alkanes
* alkenes
* alkynes
 |
| 1. ***physical properties***
 | * boiling points
* melting points
* solubility
 |
| 1. ***carboxylic acid derivatives***
 | * acid halides
* acid amides
* acid anhydrides
* esters
 |
| 1. ***nitrogen compounds***
 | * Diazonium salts
* Nitriles
* Isocyanides
* Nitroso compounds
 |
| 1. ***classification of heterocyclic compounds***
 | * Five membered heterocyclic compounds
* Six membered heterocyclic compounds
 |
| 1. ***Cosmetics***
 | * Perfumes/ deodorants
* Body lotions
* Moisturisers
* Finger nail polishers
* Lipsticks
* Hair dyes
* Toothpaste
* Shampoos
 |
| 1. ***Detergents***
 | * Solid soaps
* Fabric softeners
* All-purpose cleaners
* Liquid detergents
 |
| 1. ***Inks***
 | * Organic solvents-based inks
* Water based inks
* Oil, pigment or dyes
* Gel based ink
* Roller ball ink based
 |
| 1. ***Pharmaceutical products***
 | * Liquid
* Dry Syrups
* Tablets
* Capsules
* Injectable
 |
| 1. ***Paints***
 | * Water based
* Solvents based
 |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

**Required Skills**

The individual needs to demonstrate the following skills:

* Logical thinking
* Problem solving
* Communication skills

**REQUIRED KNOWLEDGE**

* hydrocarbons,
* haloalkanes
* hydroxyl compounds
* carbonyl compounds,
* carboxylic acids
* carboxylic acid derivatives
* amines and nitro compounds
* aromatic compounds
* heterocyclic compounds
* polynuclear aromatic compounds
* polymer chemistry,
* organic spectroscopic techniques and
* formulation chemistry

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | **Assessment requires evidence that the candidate:*** 1. Knowledge of types of ***hydrocarbons*** is demonstrated as per set standards
	2. Knowledge of naming of hydrocarbons is demonstrated as per IUPAC system
	3. Knowledge of reaction and reaction mechanism of hydrocarbons is demonstrated as per set procedures
	4. Knowledge of physical properties of haloalkanes is demonstrated as per set procedures
	5. Knowledge of reactions and reaction mechanism of haloalkanes is demonstrated as per set procedures
	6. Knowledge of classification and naming of carbonyl compounds is demonstrated as per set procedures
	7. Knowledge of preparation of carbonyl compounds is demonstrated as per set procedures
	8. Knowledge of physical properties of carbonyl compounds is demonstrated as per set procedures
	9. Knowledge of reactions and reaction mechanism of carbonyl compounds is demonstrated as per set procedures
	10. Knowledge of physical properties of carboxylic acids is demonstrated as per set procedures
	11. Knowledge of reactions and reaction mechanism of carboxylic acids is demonstrated as per set procedures
	12. Knowledge of reactions and reaction mechanism of amines and nitrogen compounds is demonstrated as per set procedures
	13. Knowledge of uses of amines and nitrogen compounds is demonstrated as per set procedures
	14. Knowledge of Kekule structures of benzene is demonstrated as per set standards
	15. Knowledge of electrophilic and nucleophilic substitution reactions and reaction mechanism of benzene is demonstrated as per set procedures
	16. Knowledge of electrophilic and nucleophilic substitution reactions and reaction mechanism of substituted benzene is demonstrated as per set procedures
	17. Knowledge of substitution reactions of heterocyclic compounds is demonstrated as per set procedures
	18. Knowledge of substitution reactions of polynuclear compounds is demonstrated as per set procedures
	19. Knowledge of naming and classification of polymers is demonstrated as per set standards
	20. Knowledge of polymerisation reactions of polymers is demonstrated as per set procedures
	21. Knowledge of uses of polymers is demonstrated as per set procedures
 |
| 1. Resource Implications
 | ***The following resources must be provided:**** 1. Access to relevant workplace or appropriately simulated environment where assessment can take place
	2. Computer
	3. Functional laboratory
	4. Reagents and chemicals
	5. Stationary
	6. Library books
 |
| 1. Methods of Assessment
 | **Competency may be assessed through:*** 1. Oral questioning
	2. Practical demonstration
	3. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through a simulated work place environment |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## 6. APPLY BIOCHEMISTRY TECHNIQUES

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

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Demonstrate knowledge of water, acids, bases and buffers
 | * 1. Knowledge of structure and properties of water is demonstrated as per the standards
	2. Knowledge roles of water in biochemistry is demonstrated as per the set standards
	3. Knowledge importance of biochemistry in analytical chemistry is demonstrated as per the set standards
	4. Knowledge of theory of acids, bases and buffers is demonstrated as per the concepts
	5. Knowledge of importance of acids, bases and buffers is demonstrated as per the set standards
 |
| 1. Demonstrate knowledge of cell biology
 | * 1. Knowledge of prokaryotes and eukaryotes is demonstrated as per set standards
	2. Knowledge of types of membrane transport processes is demonstrated as per the set standard
	3. Knowledge of cell fractionation is demonstrated as per the set standards
 |
| 1. Demonstrate knowledge of carbohydrates
 | * 1. Classify carbohydrates as per the set standards
	2. Knowledge of sources of carbohydrates is Demonstrated as per the sources
	3. Knowledge of sources of carbohydrates is demonstrated as per the set standards
	4. Knowledge of functions of carbohydrate is demonstrated
	5. Analyse carbohydrates as per the biochemical techniques
 |
| 1. Demonstrate knowledge of proteins and mineral acids
 | * 1. sources of proteins are stated as per the sources
	2. classification of amino acids is describing as per the actual classifications
	3. basic structure of amino acids and protein molecule is described as per the structure
	4. configuration of proteins is described as per the set standards
	5. chemical and physical properties of proteins is outlined as per the properties
 |
| 1. Demonstrate knowledge of lipids
 | * 1. lipids are classified as per the classifications
	2. structure of lipids is described as per the structures
	3. knowledge of types of fatty acids and glycerides is demonstrated as per the types
	4. Knowledge of functions of lipids and waxes is demonstrated as pee the functions.
	5. Knowledge of properties of lipids is demonstrated as per the property
	6. Analysis of lipids is described as per the standards
 |
| 1. Demonstrate knowledge of vitamins and minerals
 | * 1. types of minerals and vitamins are described as per the types
	2. properties of vitamin are explained as per the properties
	3. functions of vitamins and lipids are explained as per the function
	4. sources of vitamins and minerals are identified as per the vitamin and mineral
	5. analysis of minerals and vitamins is described as per the mineral and vitamin
 |
| 1. Demonstrate knowledge of enzymes and coenzymes
 | * 1. Knowledge of meaning of enzymes and coenzymes is demonstrated as per the set standards
	2. enzymes and coenzymes are Classifications as per their classification
	3. nature of enzymes and coenzymes is describing as per the nature
	4. modes of action of enzymes and is described as per the action
	5. specificity of enzyme is described as per the standard
	6. kinetics and inhibitions of enzymes is described as per the enzyme
	7. analysis of enzyme is described as per the enzyme
 |
| 1. Demonstrate knowledge of biochemical techniques
 | * 1. biochemical techniques are described as per the techniques
	2. application of biochemical techniques is stated as per the application
 |
| 1. Demonstrate knowledge of metabolism
 | * 1. Demonstrate knowledge of metabolism and catabolism as per the standards
	2. Digestion and assimilation are demonstrated as per the standards
	3. Demonstrate knowledge of disorders associated with metabolism as per the standards
 |
| 1. Demonstrate knowledge of nucleic acids
 | * 1. Knowledge of types and functions of ***nuclei acid*** is demonstrated as per the standards
	2. Knowledge of the difference between nucleotides and nucleosides is Demonstrated as per the standard
	3. Knowledge of differences between types of bases is demonstrated as per the standard
	4. Structure of deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA) is described as per the standard
 |

RANGE

This section provides work environment and conditions to which the performance

Criteria apply. It allows for different work environment and situations that will affect

Performance.

| **Variable** | **Range*****May include but is not limited to:*** |
| --- | --- |
| * + - 1. ***nuclei acid***
 | * DNA
* RNA
 |
| * + - 1. ***mineral acids***
 | * sulphuric acid
* hydrochloric acid
* nitric acid
 |
| * + - 1. ***lipids***
 | * oils
* fatty acids
* waxes
* some vitamins
* proteins
* glycerol
* steroids
* some alcohols
* fatty aldehydes
* ketone bodies
* hydrocarbons
 |
| * + - 1. ***vitamins***
 | * vitamin A
* vitamin B etc.
 |
| * + - 1. ***minerals***
 | * sodium
* calcium
* iron etc.
 |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

**Required Skills**

The individual needs to demonstrate the following skills:

* Logical thinking
* Problem solving
* Communication skills

**REQUIRED KNOWLEDGE**

* Water, Acids, bases and buffers
* Cell
* Carbohydrates
* Proteins
* Lipids
* Vitamins and minerals
* Enzymes and coenzymes
* Nucleic acids
* Metabolism

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + - 1. Critical Aspects of Competency
 | **Assessment requires evidence that the candidate:*** 1. Knowledge roles of water in biochemistry is demonstrated as per the set standards
	2. Knowledge of theory of acids, bases and buffers is demonstrated as per the concepts
	3. Knowledge of cell fractionation is demonstrated as per the set standards
	4. Knowledge of sources of carbohydrates is demonstrated as per the set standards
	5. Analyse carbohydrates as per the biochemical techniques
	6. basic structure of amino acids and protein molecule is described as per the structure
	7. chemical and physical properties of proteins is outlined as per the properties
	8. Knowledge of properties of lipids is demonstrated as per the property
	9. Analysis of lipids is described as per the standards properties of vitamin are explained as per the properties
	10. analysis of minerals and vitamins is described as per the mineral and vitamin
	11. modes of action of enzymes and is described as per the action
	12. analysis of enzyme is described as per the enzyme
	13. application of biochemical techniques is stated as per the application
	14. Demonstrate knowledge of disorders associated with metabolism as per the standards
	15. Knowledge of the difference between nucleotides and nucleosides is Demonstrated as per the standard
	16. Structure of DNA and RNA is described as per the standard
 |
| 1. Resource Implications
 | ***The following resources must be provided:***1. Access to relevant workplace or appropriately simulated environment where assessment can take place
2. Computer
3. Functional laboratory
4. Reagents and chemicals
5. Stationary
6. Library books
 |
| 1. Methods of Assessment
 | **Competency may be assessed through:*** 1. Oral questioning
	2. Practical demonstration
	3. Observation
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through a simulated work place environment |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## 7. APPLY STATISTICAL METHODS

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

**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 and apply correlation and regression

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| * + 1. Introduction to statistics
 | * 1. Statistics terms are defined per the concept
	2. Demonstrate knowledge of Branches of statistics as per the standards
	3. Knowledge of Importance and use of statistics in analytical chemistry is demonstrated as per the standards
 |
| * + 1. Apply ***Sampling*** and data collection
 | 1. Define sampling as per the standard
2. Knowledge of Types and limitation of sampling is demonstrated as per the standards
3. Knowledge of Importance of sampling is demonstrated as per the set standards
4. Knowledge and calculation of Standard error is demonstrated
5. Knowledge of Types of data is demonstrated as per the set standards
6. Knowledge of Data collection methods is demonstrated as per the standard
 |
| * + 1. Apply Presentation of data
 | * 1. Data is Tabulated as per the required tables
	2. Data is presented into Classes as per the required frequencies
	3. Analytical chemistry Data is Presented in chart form as per the required charts
	4. Charts are interpreted as per the chart’s values
 |
| * + 1. Apply ***Measures of central tendency***
 | * 1. Knowledge on Definition of Measures of the central tendency is demonstrated as per the procedures
	2. Measures of central tendency are Computed as per the procedure
	3. Measures of central tendency are determined Graphically as per the procedures
	4. Knowledge of advantages and disadvantages of measures of central tendency is demonstrated as per the procedure
	5. Measures of central tendency is applied as per the procedures
 |
| * + 1. Apply ***Measures and relative measures of dispersion***
 | * 1. Various Measures of dispersion are explained as per the dispersion
	2. Various Measures of dispersion are Computed as per the formula
	3. Measures of dispersion are applied as per the procedure
	4. Relative Measures of dispersion is defined as per the set standard
	5. Relative Measures of dispersion are Computed and interpreted as per the procedure.
 |
| * + 1. Elements of probability
 | * 1. Terms related to probability are defined as per the required standard
	2. Types of probability events are differentiated as per the events
	3. Various Laws of probability are defined as per the procedures
	4. Counting techniques in probability are applied as per the procedures
	5. Mathematical expectations are probability are determined as per the procedures
 |
| * + 1. Apply ***probability distribution***
 | * 1. Knowledge of various types and characteristics of probability distribution is demonstrated as per the procedure
	2. Mean, variance and standard deviation of probability density function are calculated as per the formulae
	3. Mean, variance and standard deviation using binomial distribution is calculated a per the procedures
	4. Calculations involving Poisson distribution are performed as per the formula
	5. Simple probability problems are solved using Normal distribution as per the formulae
 |
| * + 1. Apply Moments, skewness and kurtosis
 | * 1. Moments, skewness and kurtosis are Defined as per the procedure
	2. Computations of Moments, skewness and kurtosis is performed as per the procedures
 |
| * + 1. Apply Correlation and ***regression***
 | * 1. Correlation and related terms are defined as per the procedure
	2. Scatter diagrams are drawn and interpreted as per the drawings
	3. Knowledge of Various forms of correlations are demonstrated as per the forms
	4. Regression and its concepts are Defined as per the concepts
	5. Linear Regressions and correlation coefficients are computed and interpreted as per the coefficients
	6. Correlation and linear regressions models are applied as per the data
 |

**RANGE**

This section provides work environment and conditions to which the performance

Criteria apply. It allows for different work environment and situations that will affect

Performance.

| **Variable** | **Range*****May include but is not limited to:*** |
| --- | --- |
| * + - 1. ***Probability distribution***
 | * ***Normal***
* ***Binomial***
* ***Poison***
 |
| * + - 1. ***Measures of central tendency***
 | * ***Mean***
* ***Mode***
* ***Median***
 |
| * + - 1. ***Measures of dispersion***
 | * ***Quartile***
* ***percentiles***
* ***deciles***
 |
| * + - 1. ***Regression***
 | * ***Linear regression***
 |
|  |  |
|  |  |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* Sampling and data collection
* Presentation of data
* Measures of central tendency
* Measures of dispersion
* Elements of probability
* probability distribution
* Moments, skewness and kurtosis
* Correlation
* Regression

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | **Assessment requires evidence that the candidate:**1. Knowledge of Importance and use of statistics in analytical chemistry is demonstrated as per the standards
2. Knowledge and calculation of Standard error is demonstrated
3. Knowledge of Data collection methods is demonstrated as per the standard
4. Analytical chemistry Data is Presented in chart form as per the required charts
5. Measures of central tendency are determined Graphically as per the procedures
6. Measures of central tendency is applied as per the procedures
7. Measures of dispersion are applied as per the procedure
8. Relative Measures of dispersion are Computed and interpreted as per the procedure.
9. Mathematical expectations are probability are determined as per the procedures
10. Mean, variance and standard deviation using binomial distribution is calculated a per the procedures
11. Simple probability problems are solved using Normal distribution as per the formulae
12. Computations of Moments, skewness and kurtosis is performed as per the procedures
13. Linear Regressions and correlation coefficients are computed and interpreted as per the coefficients
14. Correlation and linear regressions models are applied as per the data
 |
| 1. Resource Implications
 | ***The following resources must be provided:**** Computer
* Internet
* Datasets
* Books in statistics
 |
| 1. Methods of Assessment
 | **Competency may be assessed through:*** Oral questioning
* Practical demonstration
* Observation
* Written texts
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through a simulated work place environment |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ANALYTICAL CHEMISTRY RESEARCH

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

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Formulate analytical chemistry problem
 | * 1. knowledge of meaning of statement of research problem is demonstrated as per set standards
	2. knowledge of techniques of selecting of research problem is demonstrated as per set standards
	3. knowledge of statement of research problem is demonstrated as per set standards
	4. the research question is formulated as per the standard requirements
	5. the objective of the analytical chemistry problem is developed as per the research question requirements
 |
| 1. Develop research proposal
 | * 1. knowledge of meaning of research proposal is demonstrated as per set standards
	2. knowledge of meaning of types of research proposal is demonstrated as per set standards
	3. knowledge of components of a research proposal is demonstrated as per set standards
	4. knowledge of significance of a research proposal is demonstrated as per set standards
	5. knowledge of identification of appropriate research tittle is demonstrated as per set standards
	6. Review of literature is done as per the problem statement
	7. Authors are cited as per the citation procedures
	8. Referencing is done as per the citations and referencing procedures
 |
| 1. Prepare research instruments
 | * 1. Develop research design as per the research problem
	2. Develop sample design as per the research problem
	3. Develop sample size as per the research objectives
	4. Develop the research instruments as per the research questions
 |
| 1. Collect analytical chemistry data
 | * 1. knowledge of definition of data is demonstrated as per set standards
	2. knowledge of identification of sources of data is demonstrated as per set standards
	3. knowledge of types of data is demonstrated as per set standards
	4. knowledge of determination of data to be collected is demonstrated as per set standards
	5. knowledge of selection of methods of data collection is demonstrated as per set standards
	6. knowledge of research instruments is demonstrated as per set standards
	7. Identify sampling point as per the research data
	8. Carry out data collection as per the sampling points
	9. Record collected data as per the data collected
 |
| 1. Analyse and interpret analytical chemistry data
 | * 1. knowledge of coding and editing of data is demonstrated as per set standards
	2. Carry out data entry as per the coded data sheet
	3. knowledge of classification of data is demonstrated as per set standards
	4. knowledge of detection of errors and omissions in data processing is demonstrated as per set standards
	5. knowledge of determination of techniques of data processing is demonstrated as per set standards
	6. knowledge of analysis of analytical chemistry data is demonstrated as per set standards
	7. knowledge of interpretation of data is demonstrated as per set standards
	8. Identify software as per the data to be analysed
 |
| 1. Prepare analytical chemistry research report
 | * 1. knowledge of summary of research findings is demonstrated as per set standards
	2. knowledge of conclusion of research findings is demonstrated as per set standards
	3. knowledge of recommendations is demonstrated as per the research findings
 |
| 1. Present analytical chemistry research report
 | * 1. knowledge of significance of report writing is demonstrated as per set standards
	2. knowledge of types of reports is demonstrated as per set standards
	3. knowledge of layout styles is demonstrated as per set standards
	4. knowledge of writing and presenting research findings is demonstrated as per set standards
 |

**RANGE**

This section provides work environment and conditions to which the performance

Criteria apply. It allows for different work environment and situations that will affect

Performance.

| **Variable** | **Range*****May include but is not limited to:*** |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* Research method
* Data analysis
* Data presentation
* Literature review
* Report writing
* Hypothesis testing
* Data collection

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * 1. Critical Aspects of Competency
 | **Assessment requires evidence that the candidate:*** 1. Demonstrate knowledge of coding of data
	2. Demonstrate knowledge of data entry
	3. Demonstrate knowledge of sorting of data
	4. Demonstrate knowledge of filtering of data
	5. Demonstrate knowledge of manipulating data
	6. Demonstrate knowledge of generating graphs, charts and tables
	7. Demonstrate knowledge generating parameter estimates for regression models
	8. Demonstrate knowledge of generating an ANOVA table
	9. Demonstrate knowledge generating random numbers
 |
| * 1. Resource Implications
 | ***The following resources must be provided:**** Computer
* Internet
* Datasets
* Books in statistics
 |
| * 1. Methods of Assessment
 | **Competency may be assessed through:*** Oral questioning
* Practical demonstration
* Observation
* Written texts
 |
| * 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through a simulated work place environment |
| * 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## DEVELOP STANDARD OPERATING TEST PROCEDURES

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

**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.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Develop analytical test purpose and objective
 | * 1. The purpose of the analytical test is developed as per the work place master specification
	2. The objective of the analytical test is developed

as per the work place master specification |
| 1. Develop analytical test scope
 | * 1. The ***parameters of the test*** are specified as per the test procedure
	2. The analytical test coverage is determining as per the test type and procedure
	3. The number of ***analytes*** is determined as per test purpose.
 |
| 1. Develop analytical quality specifications
 | * 1. The ***equipment optimisation specifications*** are determined as per type of test and procedure
	2. The ***qualitative measurements*** are specified as per the quality standards.
	3. The ***quantitative measurements*** are specified as per the quality standards.
	4. The ***input specifications*** are determined as per the test type and procedure
	5. The sample amount for test is determined as per the test type and procedure
	6. Test apparatus specifications are determined as per the test type and procedure
 |
| 1. Develop the test methodology
 | * 1. The test process is developed as per the test type
	2. Test apparatus and equipment are determined as per the test type and procedure
	3. The test method is developed as per the test type and procedure
	4. The test result record protocol is designed as per the test type and procedure
	5. The analysis method is validated as the per the standard procedure and test type
	6. The test of non -compliance method is determined as per the standard procedure.
 |
| 1. Review/improve test procedures
 | * 1. The previous test integrity is reviewed as per work procedures
	2. The test procedures are reviewed as the work place procedures
	3. The ***novel test methods*** are included as per work procedures
	4. The novel test equipment and apparatus are included as per work procedures
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range****May include but not limited to** |
| * ***parameters of the test***
 | What the test intends to determine e.g. Smell, colour, taste, identity of a substance, quantity |
| * ***analytes***
 | * compounds
* ions
* metabolites
 |
| * ***equipment optimisation specifications***
 | * equipment conditioning e.g. temperature, pressure, light intensity, wavelength, flow rates, etc
 |
| * ***qualitative measurements***
 | * time taken
* colour
* smell
 |
| * ***quantitative measurements***
 | * length
* concentration
* time
* mass
 |
| * ***input specifications***
 | * reagents and their and volume
 |
| * ***novel test methods***
 | * new test methods and technologies
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Organisational skills
* Problem solving skills
* Communication skills
* Leadership skills
* Confidentiality
* ICT literacy skills
* Report writing skills/documentation skills
* Use of Internet

**Required Knowledge**

The individual needs to demonstrate knowledge of:

There must be evidence the candidate has knowledge of:

* Instrumentation
* Occupational health and safety
* Analytical methods
* Quality control and assurance
* Laboratory procedures
* Inorganic chemistry
* Physical chemistry
* Organic chemistry
* Biochemistry

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:There must be evidence the candidate has completed the tasks outlined in the elements and performance criteria of this unit, and:1. The purpose and the objective of the analytical test is developed as per the work place master specification
2. The parameters of the test are specified as per the test procedure
3. The analytical test coverage is determined as per the test type and procedure
4. The number of analytes are determined as per test purpose.
5. The test process is developed as per the test type
6. Test apparatus and equipment are determined as per the test type and procedure
7. The test method is developed as per the test type and procedure
8. The test result record protocol is designed as per the test type and procedure
9. The analysis method is validated as the per the work standard procedure and test type
10. The test of non -compliance method is determined as per the work place procedure.
11. The equipment optimisation specifications are determined as per type of test and procedure
12. The input specifications are determined as per the test type and procedure
13. The sample amount for test is determined as per the test type and procedure
14. The previous test integrity is reviewed as per work procedures
15. The novel test methods are included as per work procedures
 |
| 1. Resource Implications
 | The following resources should be provided:* 1. Printers
	2. Computer
	3. Stationary
	4. Internet
 |
| 1. Methods of Assessment
 | Competency may be assessed through:3.1 Portfolio Assessment3.2 Interview3.3 Case Study/Situation3.4 Observation/Demonstration and oral questioning |
| 1. Context of Assessment
 | * 1. Competency may be assessed on the job, off the job or a combination of these.
	2. Off the job assessment must be undertaken in a closely simulated workplace environment.
	3. The following conditions must be met for this unit:
* use of suitable facilities, equipment and resources, including:
* a standard laboratory
* Specialised analytical instruments, laboratory reagents and equipment, standard operating procedures (SOPs) and test methods.
 |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM ANALYTICAL CHEMISTRY TECHNIQUES

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

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  | **PERFORMANCE CRITERIA*****(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Carry out ***Separation techniques***
 | * 1. Carry out Crystallization as per the procedure
	2. Carry out Filtration as per the procedure
	3. Carry out Decantation as per the procedure
	4. Carry out Sublimation as per the procedure
	5. Carry out Evaporation as per the procedure
	6. Carry out Simple distillation as per the procedure
	7. Carry out Fractional distillation as per the procedure
	8. Carry out Chromatography as per the procedure
	9. Carry out Centrifugation as per the procedure
	10. Carry out Magnetic separation as per the procedure
	11. Carry out Precipitation as per the procedure
	12. Carry out electrophoretic as per the procedure
 |
| 1. Perform ***titrimetric techniques***
 | 1. Perform [Acid-base Titrations](https://byjus.com/chemistry/acid-base-titration/) as per set standard and workplace procedures
2. Perform Redox Titrations as per set standards and workplace procedures.
3. Perform Precipitation Titrations as per set standard and workplace procedures.
4. Perform Complexometric Titrations as per set standard and workplace procedures
 |
| 1. Perform gravimetric ***techniques***
 | * 1. Physical gravimetry is performed as per the standard and workplace procedures
	2. Thermogravimetry is performed as per the standard and workplace procedures
	3. Precipitative gravimetric analysis is performed as per the standard and workplace procedures
	4. Electrodeposition gravimetry is performed as per the standard and workplace procedures
 |
| 1. Perform ***qualitative methods*** of chemical analysis
 | * 1. Colourimetry is performed as per the set standards and workplace procedures
	2. Distillation is performed as per the set standards and workplace procedures
	3. Extraction is performed as per the set standards and workplace procedures
	4. Precipitation is performed as per the set standards and workplace procedures
	5. Chromatography is performed as per the set standards and workplace procedures
	6. Spectroscopy is performed as per the set standards and workplace procedures
 |
| 1. Carry out spectroscopic methods
 | * 1. Infra-Red/FTIR test is performed as per the procedures
	2. Ultra Violet Visible test are done as per the test procedures
	3. Nuclear Magnetic Resonance test are performed as per the test procedures
 |
| 1. Perform instrumental ***methods*** of analysis
 | * 1. Spectroscopy is carried out as per the standards and work place procedure
	2. Spectrophotometry is carried out as per the standards and work place procedure.
	3. Nuclear magnetic resonance is carried out as per the standards and work place procedure
	4. Voltammetry is carried out as per the standards and work place procedure
	5. Potentiometry is carried out as per the standards and work place procedure
	6. Amperometry is carried out as per the standards and work place procedure
	7. Conductometry is carried out as per the standards and work place procedure
	8. Chromagraphimetry is carried out as per the standards and work place procedure
	9. Mass spectrometry is carried out as per the standards and work place procedure
 |
| 1. Calibrates/Optimise analytical equipment
 | * 1. Calibration of the equipment is performed as per the manufacturer’s manual
	2. Test running is done as per the manufacturer’s instructions
 |
| 1. Perform cleaning and basic service for analytical equipment
 | * 1. Routine clean-up is performed as per the manufacturer’s manual
	2. Consumables are replaced as per the manufacturer’s instructions
	3. Routine servicing is coordinated as per the manufacturer’s instructions and workplace place procedures
 |

**RANGE**

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

| **Variable** | **Range*****May include but is not limited to:*** |
| --- | --- |
| 1. ***Separation techniques***
 | * Crystallization
* Filtration
* Decantation
* Sublimation
* Evaporation
* Simple distillation
* Fractional distillation
* Chromatography
* Centrifugation
* Magnetic separation
* Precipitation
* Electrophoretic
 |
| 1. ***Titrimetric techniques***
 | * + [Acid-base Titrations](https://byjus.com/chemistry/acid-base-titration/)
	+ Redox Titrations.
	+ Precipitation Titrations.
	+ Complexometric Titrations
 |
| 1. ***Gravimetric techniques***
 | * Physical gravimetry
* Thermogravimetry,
* Precipitative gravimetric analysis
* Electrodeposition gravimetry
 |
| 1. ***Qualitative methods***
 | * Colourimetry
* Distillation
* Extraction
* Precipitation
* Chromatography
* Spectroscopy
 |
| 1. ***Instrumental methods***
 | * + Spectroscopy
	+ Spectrophotometry.
	+ nuclear magnetic resonance
	+ voltammetry
	+ coulometry
	+ potentiometry
	+ amperometry
	+ conductometry
	+ electrogravimetry
	+ chromagraphimetry
	+ mass spectrometry
 |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* + Spectroscopy
	+ Spectrophotometry.
	+ Nuclear magnetic resonance
	+ Voltammetry
	+ Coulometry
	+ Potentiometry
	+ Amperometry
	+ Conductometry
	+ Electrogravimetry
	+ Chromagraphimetry
	+ Mass spectrometry

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | **Assessment requires evidence that the candidate:*** 1. Carry out Separation techniques
	2. Perform titrimetric techniques
	3. Perform gravimetric techniques
	4. Perform qualitative methods of chemical analysis
	5. Carry out spectroscopic methods
	6. Perform instrumental methods of analysis
	7. Calibrates/Optimise analytical equipment
	8. Perform cleaning and basic service for analytical equipment
 |
| 1. Resource Implications
 | ***The following resources must be provided:**** Computer
* Internet
* Datasets
* Books in statistics
 |
| 1. Methods of Assessment
 | **Competency may be assessed through:*** Oral questioning
* Practical demonstration
* Observation
* Written texts
 |
| 1. Context of Assessment
 | Competency may be assessed individually in the actual workplace or through a simulated work place environment |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## COLLECT AND PREPARE ANALYTICAL CHEMISTRY SAMPLES

**UNIT CODE:** ASC/OS/ACHEM/CR/03/6/A

**Unit description**

This unit of competency describes the skills and knowledge to collect and prepare analytical chemistry samples. It involves Design a sampling plan, implement sampling plan, Label/code analytical samples and Preserve analytical sample

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| * + - 1. Design a sampling plan
 | * 1. The ***sample type*** is identified as per the workplace procedure
	2. ***Sampling frame*** is developed as per the sample type
	3. The sample size is identified as per the workplace procedures
	4. The sampling tools/apparatus are identified as per the sample type
	5. The sampling design/procedure is developed as per the procedures
 |
| * + - 1. Implement sampling plan
 | * 1. The sampling points are identified as per the procedure
	2. The sampling is done as per the sampling plan
 |
| * + - 1. Label/code analytical samples
 | * 1. The labels are designed as per the workplace procedures
	2. The sample is labelled as per the workplace procedures
	3. The labels are packed as per the workplace procedures
 |
| * + - 1. Preserve and transport analytical sample
 | * 1. The ***preservation conditions*** are identified as per the sample type
	2. the preservatives are identified as per the sample type
	3. The preservation is done as per the sample type
	4. The analytical sample is transported as per the sample type
	5. The sample is registered in the sample register as per the workplace procedure
	6. The sample is stored as per the workplace procedure
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range***Maybe but not limited to* |
| * ***Sampling frame***
 | Source material from which a sample is drown e.g. * Individual
* Household
* institution
 |
| * ***preservation conditions***
 | * freezing
* room temperature
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Organisational skills
* Problem solving skills
* Communication skills
* Leadership skills
* Confidentiality
* Team player
* Decision making
* Integrity

**Required Knowledge**

The individual needs to demonstrate knowledge of:

There must be evidence the candidate has knowledge of:

* Sampling plan
* Sampling tools
* Sample labelling
* Sample Preserving and transporting
* Sampling methods
* Sapling ethics

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + - * 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:There must be evidence the candidate has completed the tasks outlined in the elements and performance criteria of this unit, and:* 1. Sampling frame is developed as per the sample type
	2. The sample size is identified as per the workplace procedures
	3. The sampling design/procedure is developed as per the procedures
	4. The sampling is done as per the sampling plan
	5. The preservation conditions are identified as per the sample type
	6. the preservatives are identified as per the sample type
	7. The sample is stored as per the workplace procedure
 |
| * + - * 1. Resource Implications
 | The following resources should be provided:* + Printers
	+ Computer
	+ Sampling tools
	+ Means of transport
	+ Stationary
	+ Telephone
	+ Reagents for clinical and biological data
	+ Appropriate apparatus and equipment for experimental data
 |
| * + - * 1. Methods of Assessment
 | Competency may be assessed through:3.1 Portfolio Assessment3.2 Interview3.3 Case Study/Situation3.4 Observation/Demonstration and oral questioning |
| * + - * 1. Context of Assessment
 | * + - 1. Competency may be assessed on the job, off the job or a combination of these.
			2. Off the job assessment must be undertaken in a closely simulated workplace environment.
			3. The following conditions must be met for this unit:

use of suitable facilities, equipment and resources, including: a standard laboratorySpecialised analytical instruments, laboratory reagents and equipment, standard operating procedures (SOPs) and test methods. |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## ANALYSE AND INTERPRET ANALYTICAL CHEMISTRY DATA

**UNIT CODE: UNIT CODE:** ASC/OS/ACHEM/CR/03/6/A

**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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Receive and input analytical data
 | * 1. Raw Data is received and characterised as per the data type and the workplace procedure
	2. Data is imported from storage database as per the procedures
	3. Data is converted into ***relevant format*** as appropriate as per the ***available software***.
	4. Data entry is done as per the software
 |
| 1. Analyse the analytical data
 | * 1. calibration graphs are generated as per the analytical results
	2. standard graphs and sample graphs are compared as per the set standard
	3. confident levels are generated from the data as per the required procedures
	4. standard values and test values are compared as per the procedures
	5. values of central tendencies are calculated as per the procedure
	6. the results of the central tendencies are recorded as per the procedure
 |
| 1. Interpret output result
 | * 1. the outliers are identified as per the test results
	2. interpreted the results as per the outliers
	3. the interpretation is recorded as per the procedure
	4. conclusions are made as per the stated hypothesis
 |
| 1. Prepare report and present findings
 | * 1. A report is prepared as per the conclusion made
	2. **Presentation template** is prepared as per the report.
	3. The template is presented to the relevant stakeholders as per the workplace procedure
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
|  |  |
|  |  |
|  |  |
|  |  |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Analytical Skills
* Teamwork
* Problem solving
* Decision making
* Concentration
* Attention to detail
* Able to meet deadlines
* Communication skills
* Leadership skills
* Presentation skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Computer applications e.g. Excel, Microsoft Word, PowerPoint etc.
* Generating frequency tables, charts, line graphs, histogram, stem plot, bar graphs etc.
* Calculation of confidence intervals
* Test of hypothesis
* Generation of random numbers
* Statistical distributions

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:1. calibration graphs are generated as per the analytical results
2. standard graphs and sample graphs are compared as per the set standard
3. confident levels are generated from the data as per the required procedures
4. standard values and test values are compared as per the procedures
5. the outliers are identified as per the test results
6. interpreted the results as per the outliers
7. A report is prepared as per the conclusion made
8. Presentation template is prepared as per the report.
9. PowerPoint presentation is prepared as per the generated results
10. The results are presented to stakeholders as per the workplace procedures.
 |
| 1. Resource Implications
 | The following resources should be provided:* 1. Computer with software i.e. R, SPSS, excel etc.
	2. Projector
	3. Seminar, board rooms or a presentation room.
	4. Stationary
 |
| 1. Methods of Assessment
 | Competency may be assessed through:3.1 Portfolio Assessment3.2 Interview3.3 Case Study/Situation3.4 Observation/Demonstration and oral questioning |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## MANAGE ANALYTICAL CHEMISTRY LABORATORY, REAGENTS AND INSTRUMENTS

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

**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

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Specify analytical reagents and lab-ware for procurement
 | * 1. The analytical reagents and lab-wares identified as per the workplace procedures
	2. The specifications of the equipment are identified as per the requirements
	3. A requisition is prepared as per the workplace procedures
 |
| 1. Receive and inventory analytical reagents and lab-ware
 | * 1. The ***reagent’s specification requirements*** are confirmed as per the workplace procedures
	2. The equipment is received as per the workplace procedures
	3. The received equipment is inventoried as per the workplace procedures
	4. The lab-ware and reagents are unpacked, checked and stored as per the workplace procedures
 |
| 1. Prepare and standardise working solutions
 | * 1. The concentration of the working solution is determined as per the end use
	2. The working solutions are prepared as per the workplace procedures
	3. The prepared working solutions are standardized as per the standard procedures
	4. The standardized solutions are labelled with specifics as per the workplace procedures
	5. The remaining standardized solutions is stored as per the workplace procedures
 |
| 1. Track and maintain reagents and lab-ware re-order levels
 | * 1. The daily stock taking for reagents and lab-ware is performed as per the workplace procedures
	2. The reagents and lab-wares for reorder are specified as per the workplace procedures
	3. Requisition for restocking is done as per the workplace procedures
 |
| 1. Manage analytical chemistry laboratory housekeeping, safety and security
 | * 1. Established safe work practices and personal protective equipment (PPE) are used as per the workplace procedures
	2. Laboratory wastes, broken glassware, sharps and spillages are collected and disposed as per the workplace procedures
	3. Labelling and maintenance of warning signs is done as per the set standards and workplace procedures
	4. Sources of laboratory hazards and risks are identified based on laboratory safety requirements
	5. Laboratory safety procedures are developed according to laboratory standards
	6. Chemical and reagents are labelled as per the on-safety standards rules
	7. Lab-ware and reagents are labelled and stored as per the workplace procedure
	8. Storage cabinets are labelled as per the type and workplace procedures.
	9. Lab-wares and reagent are retrieved and restored as per their use
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range*****May include but not limited to*** |
| 1. Reagent’s specification
 | * Type of solution/reagent
* Concentration
* Volume
 |
| 1. Personal protective equipment (PPE)
 | * Dust boats
* Boots
* Goggles
* Gloves
* Head gears
* Face masks
 |
| 1. Laboratory hazards
 | * Flames
* Poisonous chemicals
* Spillages
* biological samples
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Creative thinking
* Use of computer and software
* Analytical skills
* Communication skills
* Presentation techniques
* Reporting methods
* Problem solving

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Laboratory safety and security
* First aid
* Stock taking
* Inventorying
* Types and categories of lab-wares
* Lab-ware stains
* Cleaning of lab-wares
* Detergents for removing lab-ware stains
* Lab-ware maintenance
* Properties of lab-ware
* Properties of lab reagents
* ICT

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:1. The specification requirements are confirmed as per the workplace procedures
2. The received equipment is inventoried as per the workplace procedures
3. The working solutions are prepared as per the workplace procedures
4. The prepared working solutions are standardized as per the workplace procedures
5. The daily stock taking for reagents and lab-ware is performed as per the workplace procedures
6. Established safe work practices and personal protective equipment (PPE) are used as per the workplace procedures
7. Laboratory wastes and broken glassware are collected and disposed as per the workplace procedures
8. Chemical and reagents are labelled as per the on-safety standards rules
9. Storage cabinets are labelled as per the type and workplace procedures
10. Spillages, breakages and analytical wastes are cleared and disposed as per the workplace procedures
 |
| 1. Resource Implications
 | The following resources should be provided: * 1. Equipment and reagents
	2. Laboratory and its fixtures
	3. Computer
	4. Internet
	5. Stationery
	6. Printer
 |
| 1. Methods of Assessment
 | Competency may be assessed through:3.1 Portfolio Assessment3.2 Interview3.3 Case Study/Situation3.4 Observation/Demonstration and oral questioning |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## MANAGE ANALYTICAL CHEMISTRY SAMPLES

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

**Unit description**

This unit specifies the competencies required to 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.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**These are assessable statements which specify the required level of performance for each of the elements.***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Receive, record and re-label, manage retrieval and movement management of analytical samples

  | * 1. The analytical sample received is checked as per the workplace
	2. Register the analytical samples in the store register as per the workplace procedure
	3. Re-label the analytical sample as per the laboratory coding procedure
	4. The sample for ***dispatch is*** registered in the dispatch register as per the workplace procedures
	5. The returned sample is registered in the receipts register as per the workplace procedure
 |
| 1. Secure and store analytical samples
 | * 1. Storage condition for the analytical sample is determined as per the sample
	2. Store and secure the ***chain of custody*** as per the workplace procedure
 |
| 1. Collect, segregate and dispose laboratory waste
 | * 1. The waste from laboratory work is collected as per the laboratory safety procedure
	2. The laboratory waste is separated as per the laboratory safety procedure
	3. The waste collected and separated is confined for disposal as per the workplace procedure
	4. The laboratory waste is disposed as per the type and regulations
 |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Dispatch sample
 | * Released
* Not Analysed
 |
| 1. Returned sample
 | * Analysed
* Remainder
 |
| 1. Recycled
 | * Reuse
* Repetitive
 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Creative thinking
* Waste management
* Incineration
* Chemical properties
* Safety and occupational health
* Use of computer and software to design random experiments
* Analytical skills
* Communication skills
* Numeracy skills
* Presentation techniques
* Reporting methods

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* chemical properties and reactions
* analytical techniques
* ICT
* fire fighting
* recycling techniques
* disposal techniques
* record keeping
* preservation techniques

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency
 | Assessment requires evidence that the candidate:* 1. Register the Re-label the analytical sample in the store register as per the workplace procedures
	2. Storage condition for the analytical sample is determined as per the sample
	3. The sample for dispatch is registered in the dispatch register as per the workplace procedures
	4. The waste from laboratory work is separated as per the laboratory safety procedure
	5. The laboratory waste is disposed as per the type and regulations
 |
| 1. Resource Implications
 | The following resources should be provided: * 1. Computer
	2. Incinerator
	3. Waste disposing equipment
	4. Stationery
	5. Freezer
	6. Reagents
	7. Security Safe
 |
| 1. Methods of Assessment
 | Competency may be assessed through:3.1 Portfolio Assessment3.2 Interview3.3 Case Study/Situation3.4 Observation/Demonstration and oral questioning |
| 1. Context of Assessment
 | Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.  |
| 1. Guidance information for assessment
 | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |