

**NATIONAL COMPETENCY BASED CURRICULUM**

**FOR**

**DATA MANAGEMENT AND ANALYTICS**

**LEVEL 6**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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# FOREWORD

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

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution of Kenya 2010 and this resulted 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 instruction 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 instruction allows for multiple entry and exit in TVET programmes.

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

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

**PRINCIPAL SECRETARY**

**VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

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

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

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

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

The 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, ICT SSAC, expert workers and all those who participated in the development of these Occupational Standards.

**CHAIRPERSON**

**TVET CDACC**

# ACKNOWLEDGMENT

These Occupational Standards were developed through combined effort of various stakeholders from private and public organizations. I am 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 ICT 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.

**COUNCIL SECRETARY/CEO**

**TVET CDACC**

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**ABBREVIATIONS AND ACRONYMS**

CDACC Curriculum Development, Assessment and Certification Council

DE Data Engineer

EMS Environmental Management Systems

ICT Information Communication Technology

IEEE Institute of Electrical and Electronics Engineers

IT Information Technology

LAN Local Area Network

MAN Metropolitan Area Network

OSH Occupational Health and Safety

PAN Personal Area Network

RAM Random Access Memory

POS Parts of Speech

ROM Read Only Memory

SQL Structured Query Language

TVET Technical and Vocational Education and Training

UML Unified Modeling Language

WAN Wide Area Network

KNQA Kenya National Qualification Authority

KNQF Kenya National Qualification Framework

# KEY TO UNIT CODE

 **IT/CU/DE/BC/01/6/A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

 Version control

# OVERVIEW

This course is designed to equip a Data Engineer with the competencies required to perform various types of data management and analytics other duties in the ICT sector as elaborated in the various units of learning in this curriculum.

The course consists of basic, common and core units of learning as indicated below:

**BASIC UNITS OF LEARNING**

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

**COMMON UNITS OF LEARNING**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| IT/CU/DE/CC/01/6/A | Basic Electronics  | 170 | 17 |
| **Total** | **170** | **17** |

**CORE UNITS OF LEARNING**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| IT/CU/DE/CR/01/6/A | Foundational Computer Science Skills | 160 | 16 |
| IT/CU/DE/CR/02/6/A | Mathematical Skills for Data Science | 250 | 25 |
| IT/CU/DE/CR/03/6/A | Programming Skills Using Python | 220 | 22 |
| IT/CU/DE/CR/04/6/A | Quantitative Modelling Skills | 180 | 18 |
| IT/CU/DE/CR/05/6/A | Python in Data Science | 190 | 19 |
| IT/CU/DE/CR/06/6/A | Databases and Data Warehouses | 190 | 19 |
| IT/CU/DE/CR/07/6/A | Machine Learning Applications Using Python | 260 | 26 |
| IT/CU/DE/CR/08/6/A | Data Mining and Analytics Skills in Big Data Management | 180 | 18 |
| IT/CU/DE/CR/09/6/A | Project Management Skills for Data Science | 120 | 12 |
| IT/CU/DE/CR/10/6/A | Research Skills for Data Science | 120 | 12 |
| IT/CU/DE/CR/11/6/A | Cloud Database Solutions | 160 | 16 |
|  | **TOTAL**  | **2030** | **203** |
|  | Industrial Attachment | 480 | 48 |
| **Grand Total** | **3100** | **310** |

**Entry Requirements**

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

1. Kenya Certificate of Secondary Education (K.C.S.E.) with a minimum mean grade of C- (C minus)

**Or**

1. Craft Certificate Level 5 in ICT or a related course with **one** year of continuous work experience

**Or**

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

**Trainer qualification**

A trainer for this course should have a higher qualification than the level 6.

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a Data Management and Analytics firm for a period of at least 480 hours. Attachment will be undertaken upon completion of the course or the unit of learning.

**Assessment**

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

**Certification**

A candidate will be issued with a Certificate of Competency on demonstration of competence in some units of competency. To attain the qualification Data Management and Analytics Level 6, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

##

**COMMUNICATION SKILLS**

**UNIT CODE:** IT/CU/DE/BC/01/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Communication Skills

**Duration of Unit:** 40 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Meet communication needs of clients and colleagues
 | * Communication process
* Modes of communication
* Medium of communication
* Effective communication
* Barriers to communication
* Flow of communication
* Sources of information
* Organizational policies
* Organization requirements for written and electronic communication methods
* Report writing
* Effective questioning techniques (clarifying and probing)
* Workplace etiquette
* Ethical work practices in handling communication
* Active listening
* Feedback
* Interpretation
* Flexibility in communication
* Types of communication strategies
* Elements of communication strategy
 | * Interview
* Written texts
 |
| 1. Develop communication strategies
 | * Dynamics of groups
* Styles of group leadership
* Openness and flexibility in communication
* Communication skills relevant to client groups
 | * Interview
* Written texts
 |
| 1. Establish and maintain communication pathways
 | * Types of communication pathways
 | * Interview
* Written texts
 |
| 1. Promote use of communication strategies
 | * Application of elements of communication strategies
* Effective communication techniques
 | * Interview
* Written texts
 |
| 1. Conduct interview
 | * Types of interview
* Establishing rapport
* Facilitating resolution of issues
* Developing action plans
 | * Interview
* Written texts
 |
| 1. Facilitate group discussion
 | * Identification of communication needs
* Dynamics of groups
* Styles of group leadership
* Presentation of information
* Encouraging group members participation
* Evaluating group communication strategies
 | * Interview
* Written texts
 |
| 1. Represent the organization
 | * Presentation techniques
* Development of a presentation
* Multi-media utilization in presentation
* Communication skills relevant to client groups
 | * Interview
* Written texts
 |

**Suggested Methods of Instruction**

* Discussion
* Role playing
* Simulation
* Direct instruction

**Recommended Resources**

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

**NUMERACY SKILLS**

**UNIT CODE:** IT/CU/DE/BC/02/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Numeracy Skills.

**Duration of Unit:** 60 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply a wide range of mathematical calculations for work
 | * Fundamentals of mathematics
* Addition, subtraction, multiplication and division of positive and negative numbers
* Algebraic expressions manipulation
* Forms of fractions, decimals and percentages
* Expression of numbers as powers and roots
 | * Written tests
* Assignments
* Supervised exercises
 |
| 1. Apply ratios, rates and proportions to solve problems
 | * Rates, ratios and proportions
* Meaning
* Conversions into percentages
* Direct and inverse proportions determination
* Performing calculations
* Construction of graphs, charts and tables
* Recording of information
 | * Written tests
* Assignments
* Supervised exercises
 |
| 1. Estimate, measure and calculate measurement for work
 | * Units of measurements and their symbols
* Identification and selection of measuring equipment
* Conversion of units of measurement
* Perimeters of regular figures
* Areas of regular figures
* Volumes of regular figures
* Carrying out measurements
* Recording of information
 | * Assignments
* Supervised exercises
* Written tests
 |
| 1. Use detailed maps to plan travel routes for work
 | * Identification of features in routine maps and plans
* Symbols and keys used in routine maps and plans
* Identification and interpretation of orientation of map to North
* Demonstrate understanding of direction and location
* Apply simple scale to estimate length of objects, or distance to location or object
* Give and receive directions using both formal and informal language
* Planning of routes
* Calculation of distance, speed and time
 | * Written
* Practical test
 |
| 1. Use geometry to draw and construct 2D and 3D shapes for work
 | * Identify two dimensional shapes and routine three dimensional shapes in everyday objects and in different orientations
* Explain the use and application of shapes
* Use formal and informal mathematical language and symbols to describe and compare the features of two dimensional shapes and routine three dimensional shapes
* Identify common angles
* Estimate common angles in everyday objects
* Evaluation of unknown angles
* Use formal and informal mathematical language to describe and compare common angles
* Symmetry and similarity
* Use common geometric instruments to draw two dimensional shapes
* Construct routine three dimensional objects from given nets
 |  |
| 1. Collect, organize and interpret statistical data
 | * + Classification of data
* Grouped data
* Ungrouped data
	+ Data collection
* Observation
* Recording
	+ Distinguishing between sampling and census
	+ Importance of sampling
	+ Errors in sampling
	+ Types of sampling and their limitations e.g.
* Stratified random
* Cluster
* Judgmental
	+ Tabulation of data
* Class intervals
* Class boundaries
* Frequency tables
* Cumulative frequency
	+ Diagrammatic and graphical presentation of data e.g.
* Histograms
* Frequency polygons
* Bar charts
* Pie charts
* Cumulative frequency curves
* Interpretation of data
 | * Assignments
* Supervised exercises
* Written tests
 |
| 1. Use routine formula and algebraic expressions for work
 | * + Solving linear equations
	+ Linear graphs
* Plotting
* Interpretation
* Applications of linear graphs
* Curves of first and second degree
* Plotting
* Interpretation
 | * Assignments
* Supervised exercises
* Written tests
 |
| 8. Use common functions of a scientific calculator | * Identify and use keys for common functions on a calculator
* Calculate using whole numbers, money and routine decimals and percentages
* Calculate with routine fractions and percentages
* Apply order of operations to solve multi-step calculations
* Interpret display and record result
 | * Written
* Practical test
 |

**Suggested Methods of Instruction**

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

**Recommended Resources**

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

**DIGITAL LITERACY**

**UNIT CODE:** IT/CU/DE/BC/03/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Digital Literacy

**Duration of Unit:** 60 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software
 | * Concepts of ICT
* Functions of ICT
* History of computers
* Components of a computer
* Classification of computers
 | * Written tests
* Oral presentation
 |
| 1. Apply security measures to data, hardware, software in automated environment
 | * Data security and control
* Security threats and control measures
* Types of computer crimes
* Detection and protection against computer crimes
* Laws governing protection of ICT
 | * Written tests
* Oral presentation
* Project
 |
| 1. Apply computer software in solving tasks
 | * Operating system
* Word processing
* Spread sheets
* Data base design and manipulation
* Data manipulation, storage and retrieval
 | * Oral questioning
* Project
 |
| 1. Apply internet and email in communication at workplace
 | * Computer networks
* Network configurations
* Uses of internet
* Electronic mail (e-mail) concept
 | * Oral questioning
* Written report
 |
| 1. Apply desktop publishing in official assignments
 | * Concept of desktop publishing
* Opening publication window
* Identifying different tools and tool bars
* Determining page layout
* Opening, saving and closing files
* Drawing various shapes using DTP
* Using colour pellets to enhance a document
* Inserting text frames
* Importing and exporting text
* Object linking and embedding
* Designing of various publications
* Printing of various publications
 | * Oral questioning
* Written report
* Project
 |
| 1. Prepare presentation packages
 | * Types of presentation packages
* Procedure of creating slides
* Formatting slides
* Presentation of slides
* Procedure for editing objects
 | * Oral questioning
* Written report
* Project
 |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos
* Project
* Group discussions

**Recommended Resources**

* Computers
* Printers
* Storage devices
* Internet access

**ENTREPRENEURIAL SKILLS**

**UNIT CODE:**  IT/CU/DE/BC/04/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Entrepreneurial Skills

**Duration of unit:** 100 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Demonstrate knowledge of entrepreneurship and self-employment
 | * Importance of self-employment
* Requirements for entry into self-employment
* Role of an Entrepreneur in business
* Contributions of Entrepreneurs to National development
* Entrepreneurship culture in Kenya
* Born or made entrepreneurs
 | * Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
 |
| 1. Identify entrepreneurship opportunities
 | * Business ideas and opportunities
* Sources of business ideas
* Business life cycle
* Legal aspects of business
* Assessment of product demand
* Business environment
* Factors to consider when evaluating business environment
* Technology in business
 | * Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Create entrepreneurial awareness
 | * Forms of businesses
* Sources of business finance
* Factors in selecting source of business finance
* Governing policies on Small Scale Enterprises (SSEs)
* Problems of starting and operating SSEs
 | * Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Apply entrepreneurial motivation
 | * Internal and external motivation
* Motivational theories
* Self-assessment
* Entrepreneurial orientation
* Effective communications in entrepreneurship
* Principles of communication
* Entrepreneurial motivation
 | * Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Develop business innovative strategies
 | * Innovation in business
* Small business Strategic Plan
* Creativity in business development
* Linkages with other entrepreneurs
* ICT in business growth and development
 | * Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |
| 1. Develop Business Plan
 | * Business description
* Marketing plan
* Organizational/Management
* plan
* Production/operation plan
* Financial plan
* Executive summary
* Presentation of Business Plan
 | * Case studies
* Individual/group assignments
* Projects
* Written tests
* Oral questions
* Third party report
* Interviews
 |

**Suggested Methods of Instruction**

* Direct instruction
* Project
* Case studies
* Field trips
* Discussions
* Demonstration
* Question and answer
* Problem solving
* Experiential
* Team training

**Recommended Resources**

* Case studies
* Business plan templates
* Computers
* Overhead projectors
* Internet
* Mobile phone
* Video clips
* Films
* Newspapers and Handouts
* Business Journals
* Writing materials

**EMPLOYABILITY SKILLS**

**UNIT CODE:** IT/CU/DE/BC/05/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Employability Skills

**Duration of Unit:** 80 hours

**Unit Description**

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

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management
 | * Self-awareness
* Formulating personal vision, mission and goals
* Strategies for overcoming life challenges
* Managing emotions
* Emotional intelligence
* Assertiveness versus aggressiveness
* Expressing personal thoughts, feelings and beliefs
* Developing and maintaining high self-esteem
* Developing and maintaining positive self-image
* Setting performance targets
* Monitoring and evaluating performance
* Articulating ideas and aspirations
* Accountability and responsibility
* Good work habits
* Self-awareness
* Values and beliefs
* Self-development
* Financial literacy
* Healthy lifestyle practices
* Adopting safety practices
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate interpersonal communication
 | * Meaning of interpersonal communication
* Listening skills
* Types of audience
* Public speaking
* Writing skills
* Negotiation skills
* Reading skills
* Meaning of empathy
* Understanding customers’ needs
* Establishing communication networks
* Assertiveness
* Sharing information
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate critical safe work habits
 | * Stress and stress management
* Time concept
* Punctuality and time consciousness
* Leisure
* Integratingpersonal objectives into organizational objectives
* Resources mobilization
* Resources utilization
* Setting work priorities
* Developing healthy relationships
* HIV and AIDS
* Drug and substance abuse
* Managing emerging issues
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Lead a workplace team
 | * Leadership qualities
* Power and authority
* Team building
* Determination of team roles and objectives
* Team parameters and relationships
* Individual responsibilities in a team
* Forms of communication
* Complementing team activities
* Gender and gender mainstreaming
* Human rights
* Developing healthy relationships
* Maintaining relationships
* Conflicts and conflict resolution
* Coaching and mentoring skills
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Plan and organize work
 | * Functions of management
* Planning
* Organizing
* Time management
* Decision making concept
* Task allocation
* Developing work plans
* Developing work goals/objectives and deliverables
* Monitoring work activities
* Evaluating work activities
* Resource mobilization
* Resource allocation
* Resource utilization
* Proactive planning
* Risk evaluation
* Problem solving
* Collecting, analysing and organising information
* Negotiation
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Maintain professional growth and development
 | * Avenues for professional growth
* Training and career opportunities
* Assessing training needs
* Mobilizing training resources
* Licenses and certifications for professional growth and development
* Pursuing personal and organizational goals
* Managing work priorities and commitments
* Recognizing career advancement
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate workplace learning
 | * Managing own learning
* Mentoring
* Coaching
* Contributing to the learning community at the workplace
* Cultural aspects of work
* Networking
* Variety of learning context
* Application of learning
* Safe use of technology
* Taking initiative/proactivity
* Flexibility
* Identifying opportunities
* Generating new ideas
* Workplace innovation
* Performance improvement
* Managing emerging issues
* Future trends and concerns in learning
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Demonstrate problem solving skills
 | * Critical thinking process
* Data analysis tools
* Decision making
* Creative thinking
* Development of creative, innovative and practical solutions
* Independence in identifying and solving problems
* Solving problems in teams
* Application of problem-solving strategies
* Testing assumptions
* Resolving customer concerns
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |
| 1. Manage ethical performance
 | * Meaning of ethics
* Ethical perspectives
* Principles of ethics
* Ethical standards
* Organization code of ethics
* Common ethical dilemmas
* Organization culture
* Corruption, bribery and conflict of interest
* Privacy and data protection
* Diversity, harassment and mutual respect
* Financial responsibility/accountability
* Etiquette
* Personal and professional integrity
* Commitment to jurisdictional laws
* Emerging issues in ethics
 | * Written tests
* Oral questioning
* Interviewing
* Portfolio of evidence
* Third party report
 |

**Suggested Methods of Instruction**

* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Assignments
* Q&A

**Recommended Resources**

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

**ENVIRONMENTAL LITERACY**

**UNIT CODE**:IT/CU/DE/BC/06/6/A

**Relationship to Occupational Standards**:

This unit addresses the Unit of Competency: Demonstrate Environmental Literacy

**Duration of Unit:** 40 hours

**Unit Description**

This unit describes the competencies required demonstrate environmental literacy.it involves controlling environmental hazard, controlling environmental pollution, complying with workplace sustainable resource use, evaluating current practices in relation to resource usage, identifying environmental legislations/conventions for environmental concerns, implementing specific environmental programs, monitoring activities on environmental protection/programs, analysing resource use and developing resource conservation plans.

**Summary of Learning Outcomes**

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

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** |  **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard
 | * Purposes and content of Environmental Management and Coordination Act 1999
* Storage methods for environmentally hazardous materials
* Disposal methods of hazardous wastes
* Types and uses of PPE in line with environmental regulations
* Occupational Safety and Health Standards (OSHS)
 | * Written questions
* Oral questions
 |
| 1. Control environmental Pollution control
 | * Types of pollution
* Environmental pollution control measures
* Types of solid wastes
* Procedures for solid waste management
* Different types of noise pollution
* Methods for minimizing noise pollution
 | * Written questions
* Oral questions
* Role play
 |
| 1. Demonstrate sustainable resource use
 | * Types of resources
* Techniques in measuring current usage of resources
* Calculating current usage of resources
* Methods for minimizing wastage
* Waste management procedures
* Principles of 3Rs (Reduce, Reuse, Recycle)
* Methods for economizing or reducing resource consumption
 | * Written questions
* Oral questions
* Role play
 |
| 1. Evaluate current practices in relation to resource usage
 | * Collection of information on environmental and resource efficiency systems and procedures,
* Measurement and recording of current resource usage
* Analysis and recording of current purchasing strategies.
* Analysis of current work processes to access information and data
* Identification of areas for improvement
 | * Written questions
* Oral questions
* Role play
 |
| 1. Identify Environmental legislations/conventions for environmental concerns
 | * Environmental issues/concerns
* Environmental legislations /conventions and local ordinances
* Industrial standard /environmental practices
* International Environmental Protocols (Montreal, Kyoto)
* Features of an environmental strategy
 | * Written questions
* Oral questions
 |
| 1. Implement specific environmental programs
 | * Community needs and expectations
* Resource availability
* 5s of good housekeeping
* Identification of programs/Activities
* Setting of individual roles /responsibilities
* Resolving problems /constraints encountered
* Consultation with stakeholders
 | * Written questions
* Oral questions
* Role play
 |
| 1. Monitor activities on Environmental protection/Programs
 | * Periodic monitoring and Evaluation of activities
* Gathering feedback from stakeholders
* Analyzing data gathered
* Documentation of recommendations and submission
* Setting of management support systems to sustain and enhance the program
* Monitoring and reporting of environmental incidents to concerned /proper authorities
 | * Oral questions
* Written tests
* Practical test
 |
| 1. Analyze resource use
 | * Identification of resource consuming processes
* Determination of quantity and nature of resource consumed
* Analysis of resource flow through different parts of the process.
* Classification of wastes for possible source of resources.
 | * Written tests
* Oral questions
* Practical test
 |
| 1. Develop resource Conservation plans
 | * Determination of efficiency of use/conversion of resources
* Causes of low efficiency of use of resources
* Plans for increasing the efficiency of resource use
 | * Written tests
* Oral questions
* Practical test
 |

**Suggested Methods of Instruction**

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

**Recommended Resources**

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

**OCCUPATIONAL SAFETY AND HEALTH PRACTICES**

**UNIT CODE:** IT/CU/DE/BC/07/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate Occupational Safety and Health Practices

**Duration of Unit:** 40 hours

**Unit Description**

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

**Summary of Learning Outcomes**

1. Identify workplace hazards and risk
2. Control OSH hazards
3. Implement OSH programs

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify workplace hazards and risks
 | * Identification of hazards in the workplace and/or the indicators of their presence
* Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace
* Gathering of OSH issues and/or concerns
 | * Oral questions
* Written tests
* Portfolio of evidence
* Third party report
 |
| 1. Control OSH hazards
 | * Prevention and control measures e.g. use of PPE
* Risk assessment
* Contingency measures
 | * Oral questions
* Written tests
* Portfolio of evidence
* Third party report
 |
| 1. Implement OSH

 programs | * Company OSH program, evaluation and review
* Implementation of OSH programs
* Training of team members and advice on OSH standards and procedures
* Implementation of procedures for maintaining OSH-related records
 | * Oral questions
* Written tests
* Portfolio of evidence
* Third party report
 |

**Suggested Methods of instruction**

* Assigments
* Discussion
* Q&A
* Role play
* Viewing of related videos

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# COMMON UNIT OF COMPETENCY

# BASIC ELECTRONICS

**UNIT CODE:** IT/CU/DE/CC/01/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Basic Electronic Skills

**Duration of Unit:** **170 hours**

**Unit description**

This unit specifies the competencies required to demonstrate basic skills of electronics. It involves identification of electric circuits, electronic components, understand semi-conductor theory, identify and classify memories, apply number systems and identify emerging trends in electronics.

**Summary of Learning Outcomes**

1. Identify electric circuits
2. Identify Electronic components
3. Understand Semi-conductor theory
4. Identify and classify memory
5. Apply Number Systems
6. Emerging trends in Electronics

|  |  |  |
| --- | --- | --- |
| **Learning outcomes** | **Content** | **Suggested Assessment Methods** |
| 1. Identify electrical circuits
 | * + Definition of electrical circuit.
	+ Basic electrical quantities and their units
* E.m.f in volts
* Current in Amperes
* Power in watts
* Energy in joules
* Resistance in ohms
	+ Types of electrical circuits
* Simple a.c circuits
* Simple d.c circuits
 | * Practical exercises
* Written
* Observation
* Oral
 |
| 1. Identify Electronic components
 | * + Identification of electronic components
* Resistor
* Capacitor
* Diode
* Inductor
	+ Characteristic of electronic components.
	+ Application of electronic components.
	+ Identification of integrated circuit characteristics
 | * Practical exercises
* Written
* Observation
* Oral
 |
| 1. Understand Semi-conductor theory
 | * + Definition of semiconductor and related terms
* Atom
* Atomic structure
	+ Description of the structure of matter
	+ Explanation of electrons in conductors and semiconductors
	+ Types of semiconductors materials
* Silicon
* germanium
	+ Explanation of P-type and N-types materials
* P-type
* N-type
	+ Description of P-N junction diodes operations
* Forward biasing
* Reverse biasing
* Operations of transistors
* PNP type
* NPN type
 | * Practical exercises
* Written
* Observation
* Oral
 |
| 1. Identify and classify memory
 | * + Definition of memory
	+ Classification of memories
* RAM
* ROM
* DAM
* Types of memories
* Semiconductor memories
* Magnetic memories
 | * Written
* Observation
* Oral
 |
| 1. Apply Number Systems and binary coding
 | * + Definition of number system and binary code
	+ Types of number systems
* Decimal
* Binary
* Octal
* Hexadecimal
	+ Base conversion
	+ Binary arithmetic
* Addition
* Subtraction
* Multiplication
* Division
	+ Binary codes
* 8421 BCD
* Excess-3
* Represent decimal numbers in BCD
* BCD arithmetic
* Addition
* Subtraction
* Multiplication
* Division
 | * Written
* Observation
* Oral
 |
| 1. Emerging trends in Electronics
 | * Description of emerging trends
* Explanation of challenges of emerging trends
* Coping with the emerging trends
 | * Written
* Observation
* Oral
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised activities and projects in a workshop;

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from the ICT sector;
* Industrial visits.

**Recommended Resources**

|  |
| --- |
| **Tools*** + Screw Drivers
	+ Pliers
	+ Wire cutters
	+ Wire Strippers
	+ Clamps
	+ Vises
 |
| **Equipment** * Voltmeter
* Ohmmeter
* Ammeter
* Multimeter
* Power supplies
* LCR meter
 |
| **Materials and supplies*** Circuits
* Semiconductor materials
* Conductors e.g. copper, gold, silver
* Insulators e.g. rubber, glass, mica
 |

# CORE UNITS OF LEARNING

#  FOUNDATIONAL COMPUTER SCIENCE SKILLS

**UNIT CODE:** IT/CU/DE/CR/01/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Foundational Computer Science Skills

**Duration of Unit: 160 hours**

This unit covers the competencies required to demonstrate foundational computer science skills. It involves identifying computer components, performing computer arithmetic, solving digital logic, demonstrating basic networking skills, demonstrating spreadsheet skills using MS Excel and demonstrating presentation skills using MS PowerPoint

**Summary of Learning Outcomes**

1. Identify computer components
2. Perform computer arithmetic
3. Solve digital logic
4. Demonstrate basic networking skills
5. Demonstrate spreadsheet skills using MS Excel
6. Demonstrate presentation skills using MS PowerPoint

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer components
 | * Definition of computer components
* Computer hardware
* Computer software
* Types of software
* Application software
* Systems software
* Utility software
* Components of computer hardware
* Input devices
* Output devices
* CPU
* Memory
* Secondary storage
* Functions of computer hardware components
* Functions of computer software types
* Installing and operating different Operating Systems
* Windows
* Linux
* Unix based
* Troubleshooting common I/O devices
* Resolving computer problems using task manager
* Resolving computer startup problems
* Troubleshooting disk storage
* Removing computer malware
 | * Practical exercises
* Oral tests
* Written tests
* Observation
 |
| 1. Perform computer arithmetic
 | * Number systems
* Types
* Operations
* Conversion
* IEEE-based integer and floating point representations
* Integer and floating point arithmetic
* Addition
* Subtraction
* Multiplication
 | * + Oral tests
	+ Written tests
	+ Observation
 |
| 1. Solve Digital Logic Problems
 | * Boolean algebra
* Definition of Boolean algebra
* Uses of Boolean algebra
* Key Terminology
* Boolean operations
* AND
* OR
* NOT
* NAND
* NOR
* EX-OR
* EX-NOR
* Writing Boolean Expressions
* Order of basic operations
* Symbols
* Methods of simplifying Boolean expressions
* Using algebraic functions
* Using Truth tables
* Using Karnaugh Maps
 |  * + Oral tests
	+ Written tests
	+ Observation
 |
| 1. Demonstrate networking skills
 | * Computer networking terminologies
* Computer network components
* Types of networks
* LAN
* MAN
* WAN
* PAN
* Illustration of network topologies
* Star
* Ring
* Mesh
* Bus
* Internet Protocols
* HTTP
* TCP
* FTP
* UDP
* Network troubleshooting tools
* Function of various network troubleshooting tools
* Demonstration of network troubleshooting tools as per IEEE standard
 | * Practical exercises
* Oral tests
* Written tests
* Observation
 |
| 1. Demonstrate spreadsheet skills using MS Excel
 | * Spreadsheets
* Definition
* Functions
* Examples of spreadsheets
* Creating worksheets
* Excel interface
* Types of data
* Formatting of worksheet data
* Managing a workbook
* Importing and linking
* External data sources
* Updating source data
* Refreshing excel worksheet
* Formulas and functions in MS excel
* Definitions
* Applying formulas on a data set
* demonstrating various types of excel functions
* Using name manager
* Applying functions on a data set
* Using formula auditing
* Excel data tools
* Applying Data validation
* Sorting and filtering
* Removing duplicates
* Consolidating worksheets
* Performing What-if analysis
* Analysing and summarising data using Pivot tables
* Defining fields
* Setting filters
* Creating slicers and timelines
* Visualising data using charts based on different sets of data
* Customizing and formatting charts
* Spark lines
* Pivot charts
* Exporting data in MS Excel
 | * + Practical exercises
	+ Oral tests
	+ Written tests
	+ Observation
 |
| 1. Demonstrate presentation skills using MS PowerPoint
 | * MS PowerPoint
* Definition of MS PowerPoint
* Uses of PowerPoint
* Characteristics of effective PowerPoint presentations
* Developing a PowerPoint presentation
* Gathering content requirements
* Choice of design elements
* Insertion of PowerPoint slides
* Inserting slide elements
* Adding transitions and animations
* Using different presentation views
* Normal view
* Slide sorter view
* Notes page view
* Slide show view
* Creating presentation masters
* Slide masters
* Notes master
* Handout master
* Data importation from Microsoft word and Microsoft excel
* Customizing external templates
* Creating a presentation using a set of requirements
 | * + Practical exercises
	+ Oral tests
	+ Written tests
	+ Observation
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised activities and projects in a workshop

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/specialist from the ICT sector;
* Industrial visits.

**Recommended Resources**

**Tools**

Internet, MSOffice, Computer lab

**Equipment**

* Computer

**Materials and supplies**

* Instructional material
* Stationery

**Reference materials**

* Hardware vendor specifications
* Software vendor specifications
* Trainer – recommended resources including web resources

# MATHEMATICAL SKILLS FOR DATA SCIENCE

**UNIT CODE:** IT/CU/DE/CR/02/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Mathematical Skills for DataScience

**Duration of Unit:** **250 hours**

**Unit Description:**

This unit covers the competencies required to demonstrate mathematical skills for data science. It involves performing Calculus Operations, performing Linear Algebra operations, analysing events using probability theory and analysing data using statistics.

**Summary of Learning Outcomes:**

1. Perform Calculus Operations
2. Perform Linear Algebra Operations
3. Analyse events using Probability Theory
4. Analyse data using statistics

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - 1. Perform Calculus Operations
 | * Calculus
* Definition of calculus
* Types of calculus
* Functions
* Applications of calculus in data science
* Graphing of functions
* Intercepts
* Limits
* Graphing of functions using a graphing calculator
* Differential calculus
* Computing rate of change
* Applying rules of derivatives
* Optimizing derivative functions
* Solving first and second order differential equations
* Integral calculus
* Illustrating definite and indefinite integrals
* Solving integration problems using integration by reserve chain rule and substitution
 | * + Practical tests
	+ Oral tests
	+ Written tests
 |
| * + - 1. Perform Linear Algebra Operations
 | * + Definition of Linear algebra
	+ Applications of linear algebra in data science
	+ Solving linear equations
* Methods of solving
* Formation
	+ Vectors
* Definition
* Types
	+ Illustrating vector operations
* Addition
* Subtraction
* Multiplication
* Scalar
* Dot product
	+ Matrices
* Definition
* Types
* Determinant
	+ Illustrating matrix operations
* Addition
* Scalar multiplication
* Transposition
	+ Illustrating inverse of square matrix
 | * + Practical tests
	+ Oral tests
	+ Written tests
 |
| * + - 1. Analyse events using Probability Theory
 | * Key terminologies in probability
* Samples spaces
* events
* sets
* outcomes
* Applications of probability theory in data science
* Illustrating probability axioms and counting problems
* Illustrating Permutations and combinations
* Illustrating conditional probability and multiplication rule
 | * + Practical tests
	+ Oral tests
	+ Written tests
 |
| * + - 1. Analyse data using statistics
 | * Key terminologies in statistics
* Applications of statistics in data science
* Illustrating distribution in statistics
* Binomial
* Normal
* Poison
* Illustrating data representation techniques
* Histogram
* Pie charts
* Scatter plot
* Bar graph
* Descriptive statistics
* Measures of central tendency
* Measures of spread
* Illustrating measures of central tendency
* Illustrating measures of spread
* Inferential statistics
* Linear regression
* Correlation
* Analysis of Variance
* Illustration of linear regression and correlation
 | * Practical tests
* Oral tests
* Written tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised activities and projects in a workshop

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/specialist from the ICT sector;
* Industrial visits.

**Recommended Resources**

**Tools**

Internet, Computer lab

**Equipment**

* Computer
* Calculators

**Materials and supplies**

* Instructional material
* Stationery

**Reference materials**

* Trainer – recommended resources including web resources

# PROGRAMMING SKILLS USING PYTHON

**UNIT CODE:** IT/CU/DE/CR/03/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Programming Skills UsingPython

**Duration of Unit: 220 hours**

 **Unit description**

This unit covers the competencies required to demonstrate programming skills using python. It involves identifying programming building blocks, working in the python environment, performing data operations, using control structures, applying functions for problem solving, demonstrating Object Oriented programming, handling errors in a program, working with files, demonstrating unit testing and demonstrating git version control

**Summary of Learning Outcomes**

1. Identify programming building blocks
2. Work in the Python environment
3. Perform data operations
4. Use Control Structures
5. Apply functions for problem solving
6. Demonstrate Object Oriented Programming
7. Handle errors in a program
8. Work with files
9. Demonstrate unit testing
10. Demonstrate git version control

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify programming building blocks | * Definition of programming
* Phases of program development
* Key terms used in programming
* Types of code
* Translators used in programming
* Designing program specification
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Work in the Python environment
 | * Installation of python
* Downloading python setup
* Running python setup
* Python Programming environment
* Using Python command line interpreter
* Navigating the Python IDE
* Features of python
* Python syntax
* The zen of python
* Applying Python enhancement proposal 8 (PEP 8)
* Declaring variables
* Inserting comments
* Using Python key words
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Perform data operations
 | * Python Data Types
* Illustrating Python statements
* Creating an using variables and constants
* Illustrating Python Data operations
* Creation of program to perform specified operation
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Use Control Structures
 | * Python Control structures
* Decision making statements
* Looping statements
* Demonstrating uses of different control structures in python
* Creation of programs using control structures
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Apply functions for problem solving
 | * Python functions
* Definition
* Structure
* Types of functions
* Demonstration of functions
* Creating functions
* Functions calling
* Using command line arguments
* Creation of programs to implement functions and their return values
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Demonstrate Object Oriented Programming
 | * Object oriented programming concepts (OOP)
* Definition of OOP
* Classes
* Objects
* Inheritance
* Encapsulation
* Abstraction
* Polymorphism
* Demonstrating Classes and Objects
* Declaring attributes
* Creating Methods
* Creating objects
* Calling methods
* Creation of programs to implement inheritance
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Handle errors in a program
 | * Types of errors
* Catching and raising errors
* Creation of programs using error handling
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Work with files
 | * Open files for writing
* Writing to a file
* Closing a file
* Reading a file
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Demonstrate unit testing skills
 | * Unit testing
* Definition
* Concepts
* Steps of unit testing
* Identifying test modules
* Building test cases
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Demonstrate git version control skills
 | * Git version control
* Definition
* Installing git version control
* Git commands
* Initializing a git version control repository
* Adding files to git version control
* Committing files to git version control
* Pushing files to a remote git repository
 | * Practical tests
* Oral tests
* Written tests
 |

**Suggested Methods of Instruction**

* Presentations by trainer;
* Guided learner activities and research to develop underpinning knowledge;

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from the programming field.
* Industrial visits

**Recommended Resources**

**Tools**

* Python IDE, Internet, git, GitHub

**Equipment**

* Computer

**Materials and supplies**

* Stationery

**Reference materials**

Trainer-recommended reference material including text books and web resources

# QUANTITATIVE MODELLING SKILLS

**UNIT CODE:** IT/CU/DE/CR/04/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply Quantitative Modelling Skills

Structures

**Duration of Unit: 180 hours**

**Unit Description**

This unit covers the competencies required to apply quantitative modelling skills. It involves identifying key quantitative modelling concepts, performing regression modelling, performing linear programming, applying simulation modelling techniques and performing statistical quality control.

**Summary of Learning Outcomes**

1. Identify key quantitative modelling concepts
2. Perform Regression Modelling
3. Perform Linear Programming
4. Apply simulation modelling techniques
5. Perform statistical quality control

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - 1. Identify key Quantitative Modelling Concepts
 | * + Definition of quantitative modelling
	+ Key terms in quantitative modelling
	+ Quantitative modelling techniques
	+ Definition
	+ Application
 | * Written tests
* Oral tests
 |
| * + - 1. Perform Regression Modelling
 | * + Types of regression models
	+ Linear
	+ Logistic
	+ Polynomial
	+ Ridge
	+ Lasso
	+ Key assumptions in regression
	+ Illustration of linear regression modelling
	+ Identifying the variables
	+ Defining the regression equation
	+ Solving the equation
	+ Interpreting model
	+ Evaluation of the regression model
	+ R2
	+ F-test
	+ Creating linear regression models to solve real world problems
 | * Written tests
* Oral tests
* Practical tests
 |
| * + - 1. Perform Linear Programming
 | * + Illustration of Linear programming using graphical method
	+ Steps of graphing
	+ Finding the optimal solution
	+ Illustration of Linear programming modelling using simplex method
	+ Simplex method steps
	+ Finding the optimal solution
	+ Creating linear programming models to solve a real world problems.
 | * Written tests
* Oral tests
* Practical tests
 |
| * + - 1. Apply simulation modelling techniques
 | * + Types of simulation models
	+ Monte Carlo
	+ Agent-based
	+ Discrete events
	+ System dynamics
	+ Illustration of Monte Carlo Simulation model
	+ Steps of Monte Carlo simulation modelling
	+ Interpreting a Monte Carlo model
	+ Creation of a Monte Carlo financial simulation model
 | * Written tests
* Oral tests
* Practical tests
 |
| * + - 1. Perform statistical quality control
 | * + Statistical quality control (SQC)
	+ Definition
	+ Purpose of statistical quality control
	+ Key terms in statistical quality control
	+ Specification of typical quality problems relating to manufacturing
	+ Selection and application of statistical quality control tools on given data
	+ Application of Statistical quality controls are in the Lean Six Sigma Process
	+ Definition of Six Sigma
	+ Application of SQC tools in the Six Sigma DMAIC phases
 | * Written tests
* Oral tests
* Practical tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from a relevant field
* Industrial visits.

**Recommended Resources**

**Tools**

* Internet
* Calculator
* Mathematical tables

**Equipment**

* Computer

**Materials and supplies**

* Stationery
* Instructional materials

**Reference materials**

* Trainer-recommended resources including web resources

# PYTHON IN DATA SCIENCE

**UNIT CODE:** IT/CU/DE/CR/05/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply Python in Data Science

**Duration of Unit:** **190 hours**

**Unit Description:**

This unit covers the competencies required to apply Python in Data Science. It involves identifying data science concepts, performing python data processing, performing python data visualization and performing statistical data analysis.

**Summary of Learning Outcomes:**

By the end of the unit, the trainee should be able to:

1. Identify key data science concepts
2. Perform Python data processing
3. Perform Python data visualization
4. Perform statistical data analysis

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify key data science concepts
 | * Definition of data science
* Key terms used in data science
* Foundations of data science
* Data science libraries
* Data requirements in data science
* Preparation of a data set from a specified requirement
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Perform Python data processing
 | * Installation of Python scientific libraries
* Installing Pandas
* Installing Numpy
* Choosing scientific libraries in processing python data
* Importation of data formats using pandas
* Demonstrating Exploratory Data Analysis
* Demonstrating Data formatting and data type conversions
* Demonstrating Data Cleaning
* Demonstrating pandas operations
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Perform Python data visualization
 | * Visualizations of python data
* Using Matplotlib
* Using Seaborn
* Demonstrating various types of data visualisation from given data
* Creating sub plots from given data
* Adding visualisation elements
* Creation of data visualization using a given dataset
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Perform statistical data analysis
 | * Types of Statistics
* Descriptive
* Inferential
* Demonstrating Descriptive Statistics
* Measures of Dispersion
* Measures of Central Tendency
* Demonstrating Inferential statistics
* Regression
* Correlation
* Confidence intervals
* Publication of data science blog
 | * Practical tests
* Oral
* Written tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practicals and assignments

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting expert from the ICT sector;
* Industrial visits

**Recommended Resources**

**Tools**

* Internet
* Jupyter Notebook

**Equipment**

* Computers

**Materials and supplies**

* Instructional material
* Stationery

**Reference materials**

* Trainer – recommended resources including web resources

# DATABASES AND DATA WAREHOUSES

**UNIT CODE:** IT/CU/DE/CR/06/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Design and Develop Databases and Data Warehouses

**Duration of Unit: 190 hours**

**Unit Description**

This unit covers the competencies required to demonstrate designing and development of databases and data warehouses. It involves identifying key database concepts, designing a relational database from given requirements, using Structured Query Language to implement a database design, designing a data warehouse and implementing a data warehouse

**Summary of Learning Outcomes**

1. Identify key Database concepts
2. Design a relational Database from given requirements
3. Use Structured Query Language to implement database design
4. Design a data warehouse
5. Implement a Data Warehouse Design

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify key database concepts
 | * Database
* Definition of database
* Database terminologies
* Reasons of using databases
* Definition of relational model
* Relational Modelling Concepts
* Relations/tables
* Attributes/Columns
* Domain
* Tuples/Rows
* Primary Key
* Foreign Key
* Comparison of RDBMS products
* Oracle
* MS SQL server
* MySQL
* Ms Access
* Mongo DB
* Casandra
* Installation of MS SQL server
* MS SQL server interface
* Properties of MS SQL server Database
	+ Deleting a database
	+ Deleting data or log files
	+ Increasing database size
	+ Shrinking database
	+ Renaming database
	+ Importing a database
	+ Exporting a database
* Prescription of RDBMS product for a simulated environment
* Illustration of Object Relational Mappers
 | * Oral questioning
* Written tests
* Practical tests
 |
| 1. Design a relational Database from given requirements
 | * Phases of database Design
* Conceptual database design (ERM Modeling)
* Logical database design
* Physical database design
* Illustrating Entity modelling
* Components
* Designing Entity Model using UML (Unified Modelling Language)
* Demonstrating Normalisation
* Definition
* Demonstration of normalisation
* Validating model according to the requirements / specified transactions (CRUD matrix)
 | * Written tests
* Oral questioning
* Practical tests
 |
| 1. Use Structured Query Language to implement database design
 | * SQL
* Definition
* Characteristics
* Components
* Data definition queries
	+ CREATE
	+ DROP
	+ ALTER
* Demonstration of CREATE TABLE statement
* Demonstration of CREATE TABLE constraints
* Editing table schema using SQL ALTER statement
	+ Adding an attribute
	+ Dropping an attribute
	+ Modifying attribute domain
* Dropping table using SQL DROP TABLE statement
* Using data manipulation query statements
	+ INSERT
	+ SELECT
	+ UPDATE
	+ DELETE
* Data Manipulation Query Statements
	+ Retrieving records using SELECT statement
	+ Insertion of records using INSERT INTO statements
	+ Deleting records using DELETE statement
	+ Updating records using UPDATE. SET statement
* SQL Joins
	+ Definition of a join
	+ Types of joins
* Creating and querying a database from a validated ER model.
* Creating a simple join from a database
 | * Practical
* Oral questioning
* Observation
* Written tests
 |
| 1. Design a data warehouse
 | * Data warehouse
* Definition of Data warehouse
* Terminologies used in Data warehousing
* Types of Data warehouse
* Online analytical processing (OLAP)
* Definition of OLAP
* Illustration of OLAP
* Online Transaction Processing (OLTP)
* Definition of OLTP
* Illustration of Relational-based OLAP
* Designing Data warehouse schemas
 | * Practical tests
* Oral tests
* Written tests
 |
| 1. Implement a Data warehouse Design
 | * Data Mining Query Language (DMQL)
* Definition of DMQL
* Terminologies in DMQL
* Illustrating syntax of DMQL commands
* Creating cubes and dimensional tables using schema specifications
* Performing Extract Transform Load (ETL) operations
 | * Practical tests
* Oral tests
* Written tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practical assignments and projects;

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting expert from the ICT sector;
* Industrial visits

**Recommended Resources**

* Computer
* Stationery
* Trainer-recommended resources including web resources

# MACHINE LEARNING APPLICATIONS USING PYTHON

**UNIT CODE:** IT/CU/DE/CR/07/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Develop Machine Learning ApplicationsUsing Python

**Duration of Unit: 260 hours**

 **Unit description:**

This unit covers the competencies required to develop machine learning applications. It involves identifying concepts of machine learning, developing classification-based applications, developing regression-based applications, developing clustering based applications, applying ensemble learning techniques, using cross validation to optimize machine learning methods and demonstrating model deployment skills

**Summary of Learning Outcomes**

1. Identify key concepts of machine learning

2. Develop classification-based applications

3. Develop regression-based applications

4. Develop clustering-based applications

5. Apply ensemble learning techniques

6. Use cross validation to optimize machine learning methods

7. Demonstrate model deployment skills

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify key concepts of machine learning
 | * Machine Learning
* Definition
* Machine learning techniques
* Key Terms in Machine Learning
* Importance of data preparation
* Foundations of Machine Learning
* Types of Machine Learning
* Supervised
* Unsupervised
* Applications of Machine Learning
* Scikit-learn
* Installation of Scikit-learn
* Libraries in Scikit-learn
* Prescription of Machine learning in real life problems
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Develop classification based applications
 | * Classification
* Definition
* Classification algorithms
* How classification algorithms work
* Identifying features and targets from given data
* Demonstrating data preprocessing
* Label encoding
* Scaling
* Cleaning data
* Feature extraction
* Demonstrating fitting a classifier
* Demonstrating predictions
* Demonstrating classifier Evaluation
* Evaluation on the training set
* Evaluation on the test set
* Saving the classifier
* Creation of classifiers using given data
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Develop regression based applications
 | * Regression
* Definition
* Regression algorithms
* How regression algorithms work
* Identifying features and targets from given data
* Demonstrating data preprocessing
* Label encoding
* Scaling
* Cleaning data
* Feature extraction
* Demonstrating fitting a regressor
* Demonstrating predictions
* Demonstrating regressor evaluation
* Evaluation on the training set
* Evaluation on the test set
* Saving the regressor
* Creation of regressors using given data
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Develop clustering based applications
 | * Clustering
* Definition
* Clustering algorithms
* How clustering algorithms work
* Identifying features and targets from given data
* Demonstrating data preprocessing
* Label encoding
* Scaling
* Cleaning data
* Feature extraction
* Demonstrating fitting a cluster
* Demonstrating predictions
* Demonstrating cluster evaluation
* Evaluation on the training set
* Evaluation on the test set
* Saving the cluster
* Creation of clusters using given data
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Apply ensemble learning techniques
 | * Ensemble learning
* Definition
* How it works
* Ensemble learning Algorithms
* Comparing ensemble learning methods
* Gradient boosting
* Bagging
* Advantages and disadvantages of ensemble methods
* Demonstrating ensemble learning in regression and classification using given data
* Demonstrating evaluation of the ensemble learning regressor and classifier
 |  |
| 1. Use cross validation to optimize machine learning methods
 | * Cross Validation
* Define cross validation
* How cross validation works
* Illustrating Cross validation techniques
* K-fold
* Stratified K-fold
* Leave one out cross validation (LOOCV)
* Demonstration of Cross Validation using given data
* Hyper parameter tuning using GridSearchCV
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Demonstrate model deployment skills
 | * Installation of flask
* HTTP methods and JSON
* GET
* PUT
* POST
* DELETE
* Serialization and deserialization
* Definition
* Using Flask-Mashmallow
* Connecting to a database
* Using SQLAlchemy
* Demonstration of model deployment
 | * Written tests
* Oral tests
* Practical tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practical assignments and projects

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from the ICT sector;
* Industrial visits.

**Recommended Resources**

* Python
* Computer

# DATA MINING AND ANALYTICS SKILLS IN BIG DATA MANAGEMENT

**UNIT CODE:** IT/CU/DE/CR/08/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Data Mining and Analytics Skills in Big Data Management

**Duration of Unit:** 180 hours

**Unit Description**

This unit covers the competencies required to demonstrate data mining and analytics skills in big data management. It involves identifying key concepts of data mining and big data, applying data mining techniques, visualizing real world big data problems, managing big data using Hadoop and recognizing ethical, social and legal issues in computing and big data.

**Summary of Learning Outcomes**

1. Identify key concepts of data mining and Big data
2. Apply data mining techniques
3. Visualize real world big data problems
4. Manage Big data using Hadoop
5. Recognise ethical, social and legal issues in computing and big data.

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify key concepts of data mining and Big data
 | * Data mining
* Definition of Data Mining
* Terminologies used in data mining
* Purpose for data mining
* Mineable data
* Techniques of data mining
* Technologies used in data mining
* Architecture of data mining
* Illustrating data mining Process
* Applications of data mining
* Demonstration of data pre-processing from provided data
* Big data
* Definition of big data
* The five Vs of big data
* Big data sources
* Prescribing potential big data analytics areas
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Apply data mining techniques
 | * Selecting mining technique
* Selecting data mining software mining tool
* Applying classification techniques
* Performing predictions
* Evaluating classifier
* Applying regression techniques
* Performing predictions
* Evaluating regressor
* Applying clustering techniques
* Performing predictions
* Evaluating cluster
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Visualize real world big data problems
 | * Comparison of big data visualization tools
* Visualising given data using Ms Excel
* Tables
* Pivot Tables
* Sparklines for trends
* Charts
* Pivot Charts
* Slicers
* Dashboards
* Powerpivot
* Visualising given data using Ms PowerBi
* Components of PowerBi
* Importing Data
* Refreshing PowerBi Data
* Building interactive visualization
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Manage Big data using Hadoop
 | * Hadoop
* Definition of Hadoop
* Hadoop architecture
* Hadoop environment
* Demonstrating hadoop download process
* Hadoop operation modes
* Installing appropriate Hadoop operation mode
* Verifying installation mode
* Demonstrating Hadoop launching
* Hadoop file system (HDFS)
* Features
* Illustrating HDFS architecture
* Demonstration of HDFS operations
* Installing snakebite package
* MapReduce
* Definition of MapReduce
* MapReduce Algorithm
* Demonstrating Hadoop streaming with python
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Recognise ethical, social and legal issues in computing and Big Data
 | * Definition of Ethics
* Legal and ethical issues in computing
* Legal issues
* Ethical issues
* Social issues and emerging trends in computing
* Big data ethical concerns and principles
 | * + Oral tests
	+ Written tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practical assignments and projects

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from the Computer Science sector;
* Industrial visits.

**Recommended Resources**

**Tools**

* Python IDE
* Ms Excel
* Ms PowerBi
* Hadoop

**Equipment**

* Computer

**Materials and supplies**

* Video tutorials
* Instructional materials
* Stationery

**Reference materials**

* Trainer recommended materials including web resources

# PROJECT MANAGEMENT SKILLS FOR DATA SCIENCE

**UNIT CODE:** IT/CU/DE/CR/09/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate Project Management Skills for Data Science

**Duration of Unit:** 120 hours

**Unit Description**

This unit covers the competencies required to demonstrate project management skills for data science. It involves identifying concepts in project management, demonstrating business understanding using CRISP-DM, demonstrating data understanding using CRISP-DM, demonstrating data preparation skills using CRISP-DM, demonstrating data modelling and evaluation skills using CRISP-DM and deploying data mining model using CRISP-DM.

**Summary of Learning Outcomes**

1. Identify concepts in project management
2. Demonstrate business understanding using CRISP-DM
3. Demonstrate data understanding using CRISP-DM
4. Demonstrate data preparation skills using CRISP-DM
5. Demonstrate data modelling and evaluation skills using CRISP-DM
6. Deploy data mining model using CRISP-DM

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify concepts in project management
 | * Project Management
* Definition
* Key terms
* Project Management Methodologies
* Comparing Project Management Software features
* Selecting appropriate project management methodology and software
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Demonstrate business understanding using CRISP-DM
 | * Identifying project output
* Setting objectives
* Specifying business success criteria
* Assessing the current situation
* Inventory of resources
* Requirements, assumptions and constraints
* Risk and contingencies
* Cost and benefits
* Identifying data miming goals
* Business criteria
* Specifying ata mining success criteria
* Creating a project plan using selected project management software
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Demonstrate data understanding using CRISP-DM
 | * Performing data collection
* Identifying data sources
* Selecting collection methods
* Describing data
* Data format
* Quantity of data
* Exploring data
* Distribution
* Relationships between pairs
* Simple aggregations
* Properties of significant sub-populations
* Simple statistical analysis
* Performing data verification
* Preparation of data quality report
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Demonstrate data preparation skills using CRISP-DM
 | * Selecting data selection
* Row data selection
* Column data selection
* Performing data cleaning
* Selection of clean subset of data
* Insertion of suitable defaults
* Estimation of missing data
* Demonstration of data construction
* Derived attributes
* Generated records
* Demonstration of data integration
* Merging data
* Aggregating data
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Demonstrate data modelling and evaluation skills using CRISP-DM
 | * Selecting modelling techniques
* Documenting the modelling technique
* Stating modelling assumptions
* Identifying test metrics
* Regression test metrics
* Classification test metrics
* Clustering test metrics
* Demonstrate model building
* Setting parameters
* Fitting the model
* Creating a model report
* Assessing a model
* Summarizing results
* Revising parameter settings
* Approving model based on business criteria
* Review Process
* Identifying Activities to be repeated
* Locating missed activities
* Determination of next steps
* Listing possible actions
* Decision making
 | * Oral tests
* Written tests
* Practical tests
 |
| 1. Deploy data mining model using CRISP-DM
 | * Creating model deployment plan
* Selecting Deployment strategies
* Setting timelines
* Creating a monitoring and maintenance plan
* Creating final project report and reviewing project
* Documenting Project successes
* Documenting unexpected events
* Documenting lessons learnt
* Documenting project performance
 | * Oral tests
* Written tests
* Practical tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practical assignments and projects

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from the Data Science sector;
* Industrial visits.

**Recommended Resources**

**Tools**

* Appropriate project management software
* Appropriate data mining tools

**Equipment**

* Computer

**Materials and supplies**

* Video tutorials
* Instructional materials
* Stationery

**Reference materials**

* Trainer recommended resources, including web resources

# RESEARCH SKILLS FOR DATA SCIENCE

**UNIT CODE:** IT/CU/DE/CR/10/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency**:** Demonstrate research skills for data science

**Duration of Unit: 120 hours**

**Unit Description:**

This unit covers the competencies required demonstrate research skills for data science. It involves identifying foundational research concepts, selecting and using data collection methods, organizing collected data using a statistical software tool, analyzing research data using a statistical software tool and presenting and reporting of research findings.

**Summary of Learning Outcomes:**

* + - 1. Identify foundational research concepts
			2. Select and use data collection methods
			3. Organize collected data using a statistical software tool
			4. Analyse research data using a statistical software tool
			5. Presentation and reporting of research findings

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| 1. Identify foundational research concepts
 | * Foundational research concepts for data science
* Definition
* Types of research
* Statistics in data science research
* Types of data in data science
* Qualitative
* Quantitative
* Levels of measurements for data science
* Nominal
* Ordinal
* Interval
* ratio
* Sources of data
* Primary source
* Secondary source
* Choice of sources of data for research assignments
 | * Practical tests
* Written tests
* Oral tests
 |
| 1. Select and use data collection methods
 | * Methods of data collection
* Observation
* Interviews
* Questionnaires
* Developing an interview instrument
* Developing a questionnaire instrument
* Demonstrating data collection from a research assignment
 | * Practical tests
* Written tests
* Oral tests
 |
| 1. Organize collected data using a statistical software tool
 | * Types of data in data Organisation
* Structured
* Un-structured
* Demonstrating methods of data organization
* By Location
* Alphabetically
* By Time
* By Hierarchy
* By Category
* Comparing features of statistical software tools
* Development of codebook using R
* Data Entry using Codebook
* Data cleaning using R
 | * Practical tests
* Written tests
* Oral tests
 |
| 1. Analyse research data using a statistical software tool
 | * Summarizing data using descriptive statistics in R
* Summarizing data using Inferential statistics in R
* Creating visualizations using R
 | * Practical tests
* Written tests
* Oral tests
 |
| 1. Presentation and reporting of research findings
 | * Methods of Data Presentation
* Textual
* Tabular
* Graphical
* Presentation of data using various methods
* Creating research reports using R outputs
 | * Practical tests
* Written tests
* Oral tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practical assignments and projects

**Recommended Resources**

**Tools**

* R studio
* Other statistical software
* MS Office

**Equipment**

* Computer

**Materials and supplies**

* Instructional materials
* Stationery

**Reference materials**

* Trainer-recommended resources including web resources

# CLOUD DATABASE SOLUTIONS

**UNIT CODE:** IT/CU/DE/CR/11/6/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Designing and Implementing Cloud Database Solutions

**Duration of Unit: 160 hours**

**Unit description**

This unit covers the competencies required to design and implement cloud database solutions. It involves identifying key concepts of cloud computing, designing and implementing database solutions for SQL Server, monitoring and troubleshooting database implementation in Azure.

**Summary of Learning Outcomes**

1. Identify key concepts of cloud computing
2. Design and implement database solutions for SQL Server and Microsoft Azure
3. Manage, design and implement database security and privacy
4. Monitor and troubleshoot Database implementation in Azure

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify key concepts of cloud computing
 | * + Cloud computing
* Definition
* Characteristics
* Benefits and challenges
	+ Cloud computing architecture
	+ Illustration of cloud computing technologies
	+ Illustration of cloud computing deployment models
	+ Illustration of Cloud computing service models
	+ Cloud service providers for IaaS, PaaS and SaaS
	+ Advantages and disadvantages of cloud solutions.
	+ Prescribing deployment and service model for a simulated organisation
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Design and implement database solutions for SQL Server and Microsoft Azure
 | * + Microsoft Windows Azure
* Definition
* Available Azure services Services (Paas and IaaS)
	+ Creating an account on the Azure portal
	+ Illustrating Azure Components
	+ Data Management
	+ Identity and Access
	+ Big Data and Big Compute
	+ Mobile Service
	+ Back Up
	+ Development of SQL Server database solution on Azure
	+ Creating a single database using the Azure portal
	+ Configuring firewall rules for the database
	+ Importing SQL server databases using the Data Migration Assistant (DMA)
	+ Implementing SQL Server on Azure Virtual machines
	+ Benefits of SQL Server Azure VMs
	+ Demonstration of procedure for creating SQL server virtual machine in Azure portal
* Other virtual machine types
	+ Ubuntu
	+ Redhat
	+ Centos
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Manage, design and implement database security and privacy
 | * SQL server database security issues
* Specifying security authentication and authorization requirements for database and server
	+ Implementing SQL Authentication and Authorization
	+ Comparing and demonstrating Windows authentication and mixed mode authentication
	+ Configuring server and database roles
	+ Azure SQL Database security capabilities
	+ Implementing Azure SQL server Database security capabilities
* Database security best practices in line standards including ISO 27001/27002
	+ Enabling Azure SQL databases security for best practice compliance
 | * Written tests
* Oral tests
* Practical tests
 |
| 1. Monitor and Troubleshoot Database implementation in Azure
 | * + Identification of resources that need monitoring on Azure SQL server databases
	+ Diagnosing database performance problems
	+ Running related problems
	+ Waiting related problems
	+ Selecting and configuring monitoring tools
	+ Using Azure portal monitoring chart
	+ using Query Performance Insight
	+ Enabling Automatic tuning
 | * Written tests
* Oral tests
* Practical tests
 |

**Suggested Methods of Instruction**

* Presentations and practical demonstrations by trainer;
* Guided learner activities and research to develop underpinning knowledge;
* Supervised practical assignments and projects;

The instruction may also be supplemented and enhanced by the following, if the opportunity allows:

* Visiting lecturer/trainer from ICT sector
* Industrial visits.

**Recommended Resources**

**Tools**

* Microsoft SQL Server
* Microsoft Azure
* Ubuntu
* Redhat
* Centos

**Equipment**

* Computer
* Network devices

**Materials and supplies**

* Stationery
* Instructional materials

**Reference materials**

* Trainer-recommended materials including web resources.