REPUBLIC OF KENYA

COMPETENCY BASED CURRICULUM

FOR

COMPUTER SCIENCE

KNQF LEVEL 6

ISCED PROGRAMME CODE: 0613 554B

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 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 TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this curriculum has been developed.

It is my conviction that this curriculum will play a great role towards development of competent human resource for the ICT Sector's growth and development.

PRINCIPAL SECRETARY, STATE DEPARTMENT FOR TVET
MINISTRY OF EDUCATION

PREFACE

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

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

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with ICT Sector Skills Advisory Committee (SSAC) have developed Occupational Standards for Computer Scientist. These standards will be the basis for development of competency-based curriculum for Computer Level 6.

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

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

I am grateful to the Council Members, Council Secretariat, ICT SSAC, expert workers and all those who participated in the development of this curriculum.

COUNCIL CHAIR,
TVET CDACC

ACKNOWLEDGMENT

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

I recognize with appreciation the role of the ICT Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the ICT sector for their valuable input and all those who participated in the process of developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workers in ICT Sector acquire competencies that will enable them to perform their work more efficiently.

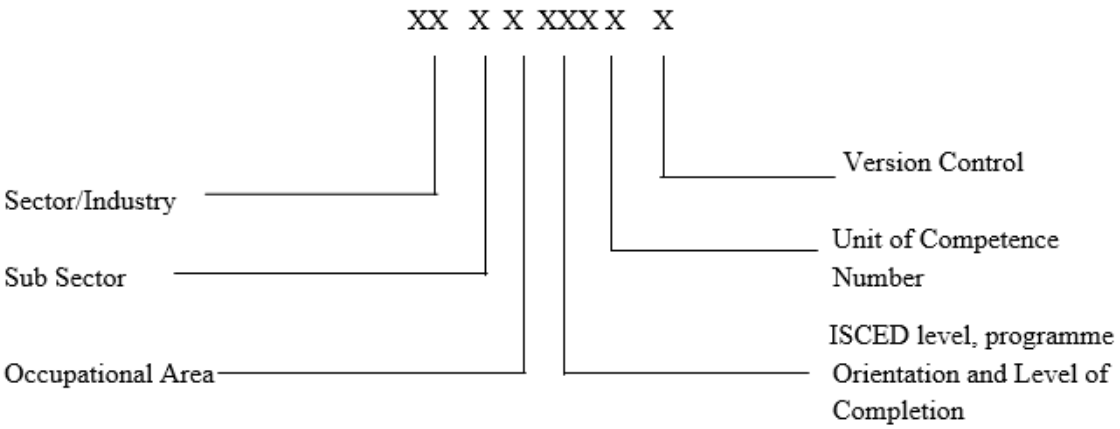
COUNCIL SECRETARY/CEO
TVET CDACC

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

A	Control version
AIDS	Acquired Immunodeficiency Syndrome
BC	Basic Unit
CBET	Competency Based Education and Training
CC	Common unit
CDACC	Curriculum Development Assessment Certification Council
CEO	Council Secretary
CR	Core Unit
CU	Curriculum
HIV	Human Immuno-Deficiency Virus
KCSE	Kenya Certificate of Secondary Education
KNQA	Kenya National Qualifications Authority
LCD	Liquid Crystal Display
OSH	Occupational Safety and Health
PESTEL	Political Environmental Social Technological Economic Legal
PPE	Personal Protective Equipment
Q&A	Questions and Answer
SSAC	Sector Skills Advisory Committee
SWOT	Strength Weakness Opportunity Threat
TVET	Technical and Vocational Education and Training

KEY TO UNIT CODE



COURSE OVERVIEW

Computer Science Level 6 qualification consists of competencies that an individual must possess to offer Computer Science Services. It involves understanding computer organization and architecture, understanding operating systems, understanding mathematics for computer science, understanding fundamentals programming, demonstrating database management skills, developing an information system, understanding networking and distributed systems, understanding artificial intelligence, understanding algorithms and data structures, demonstrating web design skills and understanding graphic design.

Units of learning comprising Computer Science Level 6 qualification include the following basic, common and core units:

Basic Units of Learning

Unit Code	Unit Title	Duration in Hours	Credit Factor
CT/CU/CS/BC/01/6/B	IT Communication Skills	60	6
CT/CU/CS/BC/02/6/B	Work ethics and practices	50	5
CT/CU/CS/BC/03/6/B	Entrepreneurial skills	60	6
Subtotal 1		**170**	**17**

Common Unit of Learning

Unit Code	Unit Title	Duration in Hours	Credit Factor
ICT/CU/CS/CC/01/6/B	Basic Electronic Skills	170	17.0
Subtotal 2		**170**	**17.0**

Core Units of Learning

Unit Code	Unit Title	Duration in Hours	Credit Factor
ICT/CU/CS/CR/01/6/B	Computer organization and architecture	140	14.0
ICT/CU/CS/CR/02/6/B	Operating systems	130	13.0
ICT/CU/CS/CR/03/6/B	Mathematics for computer science	140	14.0
ICT/CU/CS/CR/04/6/B	Fundamentals of programming	180	18.0
ICT/CU/CS/CR/05/6/B	Database management skills	160	16.0
ICT/CU/CS/CR/06/6/B	Information system	150	15.0

ICT/CU/CS/CR/07/6/B	Networking and distributed systems	210	21.0
ICT/CU/CS/CR/08/6/B	Artificial intelligence	180	18.0
ICT/CU/CS/CR/09/6/B	Algorithms and data structures	170	17.0
ICT/CU/CS/CR/10/6/B	Web design skills	200	20.0
ICT/CU/CS/CR/11/6/B	Graphic design	170	17.0
ICT/CU/CS/CR/12/6/B	Industrial attachment	480	48.0
Subtotal 3		**2310**	**231.0**
Grand Total		**2650**	**265**

Entry Requirements

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

a) Kenya Certificate of Secondary Education (KCSE) C- (Minus)

Or

b) Equivalent qualification as determined by the relevant regulatory body

Credit Accumulation, Transfer and Exemptions

TVET CDACC guidelines on credit accumulation and transfer shall apply.

Trainers Qualification

Qualifications of a trainer for Computer Science Level 6 include:

a) Possession of a higher qualification than Computer Science Level 6 or in related trade area; and

b) License by TVETA.

Industrial attachment

An individual enrolled in this course will undergo industry training for a minimum period of 480 hours in an ICT firm.

Assessment

The course shall be assessed formatively and summatively:

a) During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
b) Summative assessment shall focus more on critical aspects of the Unit of competency.
c) During summative assessment basic and common units shall be integrated or assessed concurrently with the core units.
d) Formative and summative assessment weights shall constitute 60% and 40% of the

overall score respectively.

e) Theory and practical weight shall be 50:50 respectively for each unit of learning;
f) For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:
   i) Obtained at least 40% in theory assessment in formative and summative assessments.
   ii) Obtained at least 50% in practical assessment in formative and summative assessment where applicable.
   iii) Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
g) Assessment performance rating for each unit of competency shall be as follows:

MARKS	COMPETENCE RATING
80 -100	Mastery
65 - 79	Proficiency
50 - 64	Competent
49 and below	Not Yet Competent
Y	Assessment Malpractice/irregularities

h) Assessment for Recognition of Prior Learning (RPL) may lead to award of part and/or full qualification

Certification

An individual will be awarded a Certificate of Competency on demonstration of competence in a core unit of competency. To be awarded full Computer Science Level 6 certificate, an individual must demonstrate competence in all the units of competency in this qualification pack.

BASIC UNITS OF LEARNING

IT COMMUNICATION SKILLS

UNIT CODE: CT/CU/CS/BC/01/6/B

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Apply IT Communication Skills

Duration of Unit: 60 hours

Unit Description
This unit covers the competencies required to apply communication skills. It involves applying communication channels, written, non-verbal, oral, group communication skills and job entry techniques.

Summary of Learning Outcomes

1. Apply communication channels.
2. Apply written communication skills.
3. Apply non-verbal skills.
4. Apply oral communication skills.
5. Apply group communication skills.
6. Apply job entry techniques.

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply communication channels	• Communication process • Principles of effective communication • Channels/medium/modes of communication • Factors to consider when selecting a channel of communication • Barriers to effective communication • Flow/patterns of communication • Sources of information • Organizational policies	• Oral questions • Written assessment • Observation • Portfolio of Evidence • Practical assessment • Third party report
2. Apply written communication skills	• Types of written communication • Elements of communication	• Oral assessment • Written assessment • Observation

Learning Outcome	Content	Suggested Assessment Methods
	• Organization requirements for written communication	• Portfolio of Evidence • Practical assessment • Third party report
3. Apply non-verbal communication skills	• Utilize body language and • gestures • Apply body posture • Apply workplace dressing code	• Oral assessment • Written assessment • Observation • Portfolio of Evidence • Practical assessment • Third party report
4. Apply oral communication skills	• Types of oral communication pathways • Effective questioning techniques • Workplace etiquette • Active listening	• Oral assessment • Written assessment • Observation • Portfolio of Evidence • Practical assessment • Third party report
5. Apply group discussion skills	• Establishing rapport • Facilitating resolution of issues • Developing action plans • Group organization techniques • Turn-taking techniques • Conflict resolution techniques • Team-work	• Oral assessemnt • Written assessment • Observation • Portfolio of Evidence • Practical assessment

6. Apply job entry techniques	• Types of job opportunities
	  ◦ Self employment
	  ◦ Service provision
	  ◦ product development
	  ◦ salaried employment
	• Sources of job opportunities
	• Resume/ curriculum vitae
	  • What is a CV
	  • How long should a CV be
		• Observation
		• Oral assessment
		• Portfolio of evidence
		• Third party report
		• Written assessment

Learning Outcome	Content	Suggested Assessment Methods
	• What to include in a AC • Format of CV • How to write a good CV • Don'ts of writing a CV • Job application letter • What to include • Addressing a cover letter • Signing off a cover letter Portfolio of Evidence • Academic credentials • Letters of commendations • Certification of participations • Awards and decorations Interview skills • Listening skills • Grooming • Language command • Articulation of issues • Body language • Time management • Honesty • Generally knowledgeable in current affairs and technical area	

Suggested Methods of Instruction

- Discussion
- Roleplaying
- Simulation
- Direct instruction
- Demonstration

- Field trips

Recommended Resources for 25 trainees

General Resources	Tools and Equipment	Materials and Supplies
• 25 Desktop computers/laptops	Mobile phones	Flashcards
• Internet connection		Flip charts
• 1 Projector • 1 Printer		2 packets of assorted colors of whiteboard marker pens
• 1 Whiteboard		Printing papers
• Report writing templates		

WORK ETHICS AND PRACTICES

UNIT CODE: CT/CU/CS/BC/02/6/B

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Apply work ethics and practices.

Duration of Unit: 50 hours

Unit Description
This unit covers competencies required to demonstrate employability skills. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving, and promote customer care.

Summary of Learning Outcomes

1. Apply self-management skills
2. Promote ethical practices and values
3. Promote Teamwork
4. Maintain professional and personal development
5. Apply Problem-solving skills
6. Promote Customer care.

Learning Outcomes, Content, and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply self-management skills	● Self-awareness ● Formulating personal vision, mission, and goals ● Healthy lifestyle practices ● Strategies for overcoming work challenges ● Emotional intelligence Coping with Work Stress. Assertiveness versus aggressiveness and passiveness ● Developing and maintaining high self-esteem ● Developing and maintaining positive self-image ● Time management ● Setting performance targets	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical

Learning Outcome	Content	Suggested Assessment Methods
	● Monitoring and evaluating performance targets	
2. Promote ethical work practices and values	● Integrity ● Core Values, ethics and beliefs ● Patriotism ● Professionalism ● Organizational codes of conduct ● Industry policies and procedures	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical
3. Promote Teamwork	Types of teams Team building Individual responsibilities in a team Determination of team roles and objectives Team parameters and relationships Benefits of teamwork Qualities of a team player Leading a team Team performance and evaluation Conflicts and conflict resolution Gender and diversity mainstreaming Developing Healthy workplace relationships Adaptability and flexibility Coaching and mentoring skills	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical
4. Maintain professional and personal development	● Personal vs professional development and growth ● Avenues for professional growth ● Recognizing career advancement ● Training and career opportunities ● Assessing training needs ● Mobilizing training resources ● Licenses and certifications for	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical

Learning Outcome	Content	Suggested Assessment Methods
	professional growth and development ● Pursuing personal and organizational goals ● Managing work priorities and commitments ● Dynamism and on-the-job learning	
5. Apply Problem-solving skills	● Causes of problems ● Methods of solving problems ● Problem-solving process ● Decision making ● Creative thinking and critical thinking process in development of innovative and practical solutions	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical
6. Promote Customer Care	● Identifying customer needs ● Qualities of good customer service ● Customer feedback methods ● Resolving customer concerns ● Customer outreach programs ● Customer retention	● Observation ● Written assessment ● Oral assessment ● Third party reports ● Portfolio of evidence ● Project ● Practical

Suggested Methods of Instruction

- Instructor lead facilitation of theory using active learning strategies.
- Demonstrations
- Simulation/Role play
- Group Discussion
- Presentations
- Projects
- Case studies
- Assignments

Recommended Resources for 25 Trainees

- Computers

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

ENTREPRENEURIAL SKILLS

UNIT CODE: CT/CU/CS/BC/03/6/B

Relationship to occupational standards

This unit addresses the unit of competency: Apply Entrepreneurial skills.

Duration of unit: 60 hours

Unit Description:

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, and developing business innovative strategies and business plans.

Summary of Learning Outcomes

1. Apply financial literacy
2. Apply the entrepreneurial concept
3. Identify entrepreneurship opportunities
4. Apply business legal aspects
5. Innovate Business Strategies
6. Develop business plan

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply financial literacy	• Personal finance management • Balancing between needs and wants • Budget Preparation • Saving management • Factors to consider when deciding where to save • Debt management • Factors to consider before taking a loan • Investment decisions • Types of investments • Factors to consider when investing money	• Observation • Project • Written assessment • Oral assessment • Third party report • Interviews

Learning Outcome	Content	Suggested Assessment Methods
	• Insurance services • insurance products available in the market • Insurable risks	
2.Apply entrepreneurial concept	• Difference between Entrepreneurs and Business persons • Types of entrepreneurs • Ways of becoming an entrepreneur • Characteristics of Entrepreneurs • salaried employment and self-employment • Requirements for entry into self-employment • Roles of an Entrepreneur in an enterprise • Contributions of Entrepreneurship	• Observation • Project • Written assessment • Oral assessment • Third party report
3.Identify entrepreneurship opportunities	• Sources of business ideas • Factors to consider when evaluating business opportunity • Business life cycle	• Observation • Project • Written assessment • Oral assessment • Third party report
4.Apply business legal aspects	• Forms of business ownership • Business registration and licensing processing • Types of contracts and agreements • Employment laws • Taxation laws	• Observation • Project • Written assessment • Oral assessment • Third party report
5.Innovate business Strategies	• Creativity in business • Innovative business strategies • Entrepreneurial Linkages • ICT in business growth and development	• Observation • Project • Written assessment • Oral assessment • Third party report
6.Develop Business Plan	• Business description	• Observation

Learning Outcome	Content	Suggested Assessment Methods
	• Marketing plan • Organizational/Management • plan • Production/operation plan • Financial plan • Executive summary • Business plan presentation • Business idea incubation	• Written assessment • Project • Oral assessment • Third party report

Suggested Methods of Instruction

- Direct instruction with active learning strategies
- Project (Business plan)
- Case studies
- Field trips
- Group Discussions
- Demonstration
- Question and answer
- Problem solving
- Experiential
- Team training
- Guest speakers

Recommended Resources for 25 Trainees

- 5 Case studies
- 5 Business plan templates
- 10 Computers
- 1 Overhead projectors
- Internet
- Video clips
- 5 Newspapers and Handouts
- 5 Business Journals
- 25 sets of Writing materials

COMMON UNITS OF LEARNING

BASIC ELECTRONICS

UNIT CODE: ICT/CU/CS/CC/01/6/B

Relationship to Occupational Standards
This unit addresses the unit of competency: Apply Basic Electronic Skills

Duration of Unit: 170 hours

Unit description
This unit specifies the competencies required to apply basic electronics skills. It involves identifying electric circuits and electronic components, understanding semi-conductor theory, identifying and classifying memories, applying number systems and binary coding and identifying 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 and binary coding
6. Identify emerging trends in electronics

Learning Outcomes, Content and Suggested Assessment Methods

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

2. Identify electronic components	• Identification of electronic components • Resistor	• Practical exercises • Written • Observation

	• Capacitor • Diode • Inductor • Characteristic of electronic components. • Application of electronic components. • Identification of integrated circuit characteristics	• Oral
3. 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
4. Identify and classify memory	• Definition of memory • Classification of memories • RAM • ROM • DAM • Types of memories • Semiconductor memories • Magnetic memories	• Written • Observation • Oral

5. 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

6. 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;
- 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

COMPUTER ORGANISATION AND ARCHITECTURE

UNIT CODE: ICT/CU/CS/CR/01/6/B

Relationship to Occupational Standards
This unit addresses the unit of competency: Understand Computer Organization and Architecture

Duration of Unit: 140 hours

Unit description
This unit covers the competencies required to understand computer organisation and architecture. It involves understanding principles of computer organisation and design, understanding central processing unit functions, understanding computer memory organization, understanding input-output functions and understanding computer arithmetic and logic.

Summary of Learning Outcomes

1. Understand principles of Computer Organisation and Design
2. Understand Central Processing Unit functions
3. Understand computer memory organization
4. Understand Input-Output functions
5. Understand computer arithmetic and logic

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand principles of computer organisation and design	• Definition of ICT
	• Application areas of ICT
	• Definition of Computer Organisation
	• Description of Computer Architecture
	• Computer Memory Organization
	• Structure and function of computer components
	  ◦ Basic components
	  ◦ Functions of components
	• Identification of computer hardware components
	• Input – Output Organization
		• Practical tests
		• Observation
		• Oral tests
		• Written tests

2. Understand input-output organization	• Peripheral devices
	  • Categories of peripheral devices
	  • Standard I/O devices specification factors
	• Input-output processing
	• Role of Bus interface in I/O
	• Modes of data transfer
	  • Programmed I/O
	  • Interrupt initiated I/O
	  • Direct memory access(DMA)
	• I/O devices' specifications as per user needs
	• Verification of computer I/O devices' specifications
		• Practical tests
		• Observation
		• Oral tests
		• Written tests

3. Understand computer memory organization	• Computer Memory Organization
	  • Functions
	  • Categories of internal memory
	  • Standard memory specification factors
	• Storage technologies
	  • Solid state storage devices
	  • Optical storage devices
	  • Magnetic storage devices
	• Cache and Virtual memory
	  • Definitions
	  • Operations of cache and virtual memory
	• Prescription of memory specifications as per user needs
	• Verification of memory specifications for a given computer
		• Practical tests
		• Observation
		• Oral tests
		• Written tests

4. Understand central processing unit functions	• Central Processing Unit
	  • Types of processors
	  • Processor generations
	  • Standard CPU specification factors
		• Practical tests
		• Observation
		• Oral tests
		• Written tests

	• CPU architecture
	  • Arithmetic and Logic Unit
	  • Control Unit
	  • Buses
	• Register
	  • Definition
	  • Types of registers
	• Instruction representation and execution
	  • Instruction set
	  • Fetch Execute Cycle
	• Prescription of CPU specifications as per user needs
	• Verification of computer CPU specifications	

5. Understand computer arithmetic and logic	• Number systems
	  • Types
	  • Operations
	  • Conversion
	• IEEE-based Integer and Floating point representations
	• Integer and Floating point arithmetic
	  • Addition
	  • Subtraction
	  • Multiplication
	• Logic operators
	  • OR
	  • AND
	  • NAND
	  • NOR
	  • NOT
	• Logic operations
	  • Addition
	  • Multiplication
	  • Subtraction
	  • Division
	• Demonstrating methods of representing logic operations
	  • Truth table
		• Practical tests
		• Observation
		• Oral tests
		• Written tests

	• Karnaugh maps • Logic gates	

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

Recommended Resources

Tools

Internet

Equipment

- Computer
- Separate/disassembled hardware components, including
  - CPUs
  - Memory modules
  - Disks
- Peripheral device

Materials and supplies

- Instructional material
- Stationery

Reference materials

- Hardware vendor specifications
- Trainer – recommended resources including web resources

OPERATING SYSTEMS

UNIT CODE: ICT/CU/CS/CR/02/6/B

Relationship to Occupational Standards
This unit addresses the unit of competency: Understand Operating Systems

Duration of Unit: 130 hours

Unit Description:
This unit covers the competencies required to understand operating systems. It involves understanding fundamentals of operating systems, applying computer application softwares to solving tasks, understanding process management, understanding memory management, understanding input-output management and understanding file management.

Summary of Learning Outcomes:

1. Understand fundamentals of operating systems
2. Apply computer application softwares to solving tasks
3. Understand process management
4. Understand memory management
5. Understand Input and Output management
6. Understand file management

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand fundamentals of operating systems	• Computer software
	  ◦ Definition
	  ◦ Classification
	• Operating system
	  ◦ Definition
	  ◦ Concepts
	  ◦ Functions of operating system are identified.
	• Operating system structures
	  ◦ Monolithic
	  ◦ Layered
	  ◦ Virtual
	  ◦ Client-server model
	• Types of operating systems
	• Requirements for Windows OS installation
		• Practical exercises
		• Oral tests
		• Written tests
		• Observation

	• Demonstration of Windows installation
	  • Specify hardware requirements
	  • Back up data in target machine
	  • Partition creation and/or formatting
	  • Installation as per vendor instructions
	  • Testing installation	

2. Apply computer application softwares to solve tasks	• Operating system
	• Word processing
	  • Functions and concepts of word processing.
	  • Documents and tables creation and manipulations
	  • Mail merging
	  • Word processing utilities
	  • Printing
	• Presentation Packages;
	  • Types of presentation Packages
	  • Creating, formulating, running, editing, printing and presenting slides and handouts
	• Spread sheets
	• Meaning, formulae, function and charts, uses and layout
	• Data formulation, manipulation and application to cells
	• Printing
	• Data base design and manipulation
	  • Database design, data manipulation, sorting,
		• Oral questioning
		• Project
		• Practical tests
		• Written tests

	indexing, storage retrieval and security
	• Data manipulation, storage and retrieval
	• Office Internet and Electronic mail;
	  • Office internet Connectivity
	  • Internet Browsing
	  • Electronic mail	

3. Understand process management	• Process management
	  • Definitions: Process, Thread, Process Control Block
	  • Functions of the Process Manager
	• Computer Resources
	• Process states and their transition
	  • States: Ready, Waiting, Complete, Running
	  • Transitions: Dispatch, Suspend, Exit, Resume
	• Process scheduling
	  • Features of scheduling algorithms
	  • Types of schedulers
	  • Scheduling algorithms
	• Demonstration of Task Manager
	  • Observing CPU queue
	  • Stopping CPU intensive processes.
	• Performance monitor tools in process management
		• Practical exercises
		• Oral tests
		• Written tests
		• Observation

4. Understand memory management	• Memory Management
	  • Definition
	  • Objectives of Memory management
		• Practical exercises
		• Oral tests
		• Written tests
		• Observation

	• Components of the Memory Management unit
	• Memory management techniques
	  • Partitioning
	  • Virtual memory:
	• Paging, Segmentation
	• Demonstration of virtual memory settings – Increasing the Windows page file size	

5. Understand input and output management	• Input - output management
	  • Definition
	  • Objectives of I/O management
	  • I/O hardware
	  • I/O software
	  • Polling Vs Interrupt drive I/O
	• Disk operations
	  • Access time factors
	  • Techniques for resolving slow disk I/O
	• Computer clock system
	  • Virtual Input Output
	  • Definition of Virtual I/O
	  • Types of virtual I/O: Buffering, Spooling, Caching
	• Disk selection criteria
	  • Size
	  • Speed
	• Disk properties in Windows
	• Demonstration of disk storage management operations
	  • Formatting volume
	  • Partitioning volume
	  • Shrinking volume
	  • Extending volume
	  • Optimising and defragmenting disk
	  • Changing drive security permissions
	  • Backing up
	  • Copying data to optical disks
	  • Handling removable media
		• Practical exercises
		• Oral tests
		• Written tests
		• Observation

	• Demonstration of device management operations using Windows Device Manager
	  • Verifying installed drivers
	  • Resolving driver conflicts	

5. Understand file management	• File management
	  • Definition
	  • Objectives of file manager
	  • File naming concepts
	• File access methods
	  • Sequential access
	  • Direct/Random access
	  • Indexed sequential access
	• File allocation techniques
	  • Contiguous
	  • File Allocation
	  • Indexed
	• File protection and security
	  • Importance
	  • Access control
	  • Audit trial
	• Demonstration of file and directory operations
	  • Creating folders and files
	  • Renaming folders and files
	  • Deleting folders and files
	  • Copying and Moving folders and files
	  • Setting file attributes
	• Local security policy settings
	  • Password policy
	  • Account lockout policy
	  • Audit policy
	  • Security options
		• 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;
- Visiting lecturer/trainer from the ICT sector;
- Industrial visits.

Recommended Resources

Tools

- Windows Operating system

Equipment

- Computers

Materials and supplies

- Instructional materials
- Stationery

Reference materials

- Trainer-recommended resources including web resources

MATHEMATICS FOR COMPUTER SCIENCE

UNIT CODE: ICT/CU/CS/CR/03/6/B

Relationship to Occupational Standards

This unit addresses the unit of competency: Understand Mathematics for Computer Science

Duration of Unit: 140 hours

Unit description

This unit specifies the competencies required to understanding linear algebra, understanding Boolean algebra, understanding set theory, understanding calculus and understanding probability and statistics.

Summary of Learning Outcomes

1. Understand Linear Algebra
2. Understand Boolean Algebra
3. Understand Set Theory
4. Understand Calculus
5. Understand Probability and Statistics

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand Linear Algebra	• Linear Equations
	• Definition
	• Types
	• Solving linear equations
	  • Methods of solving
	  • Formation
	• Vectors
	  • Definition
	  • Types
	• Vector operations
	  • Addition
	  • Subtraction
	  • Multiplication
	  • Scalar
	  • Dot product
	• Matrices
	  • Definition
	  • Types
		• Practical tests
		• Oral tests
		• Written tests

	• Determinant • Application • Matrix operations • Addition • Scalar multiplication • Transposition • Inverse of square matrix	
2. Understand Boolean Algebra	• Boolean algebra • Definition of Boolean algebra • Uses of Boolean algebra • Key Terminology • Boolean value • Boolean function • Digital logic • Basic Boolean operations • AND • OR • NOT • Secondary operations • NAND • NOR • EX-OR • EX-NOR • Writing Boolean Expressions • Order of basic operations • Symbols • Simplification of Boolean expressions • Using algebraic functions • Using Truth tables • Using Karnaugh Maps • Boolean Laws and Theorems • AND law • OR law • Inversion law • Commutative • Associative	• Practical tests • Oral tests • Written tests

	• Distributive • De-Morgan's Theorems • Simplification (Reduction) Rules for Boolean expressions	
3. Understand Set Theory	• Sets Theory • Definition of a Set • Characteristics of sets • Methods of Set representation • Statement form • Tabular form • Set builder notation • Cardinality of a set • Types of sets • Finite • Infinite • Subset • Universal • Proper • Singleton set • Venn Diagrams • Set Operations • Set Union • Set Intersection • Set Difference • Complement of Set • Cartesian Product	• Practical tests • Oral tests • Written tests
4. Understand Calculus	• Functions • Definition of function • Domain • Range • Linear functions • Power functions • Evaluation • Graphing of functions • Intercepts • Limits • Differential calculus • Rate of change • Rules of derivatives	• Oral • Observation • Written

	• Optimization
	• First and second order differential equations
	• Integral calculus
	  • Definite
	  • Indefinite
	• Techniques of integration
	  • By parts
	  • Reserve chain rule
	  • u-substitution	

5. Understand Probability and Statistics	• Key terminologies in probability
	  • Samples spaces
	  • events
	  • sets
	  • outcomes
	• Probability axioms and counting problems
	• Permutations and combinations
	• Conditional probability and multiplication rule
	• Data representation techniques
	  • Histogram
	  • Pie charts
	  • Scatter plot
	  • Bar graph
	• Measures of central tendency
	  • Mean
	  • Mode
	  • Median
	• Measures of spread
	  • Variance
	  • Standard deviation
	• Measure of Location
	  • Quartile
	  • Percentile
		• Practical tests
		• Oral tests
		• Written tests

Suggested Methods of Instruction

- Presentations by trainer;

- Guided learner activities and research to develop underpinning knowledge;
- Visiting lecturer/trainer from the Mathematics field.
- Industrial visits

Recommended Resources

Tools

- Internet

Equipment

- Calculator
- Computer

Materials and supplies

- Instructional material
- Stationery

Reference materials

Trainer-recommended reference material including text books and web resources

FUNDAMENTALS OF PROGRAMMING

UNIT CODE: ICT/CU/CS/CR/04/6/B

Relationship to Occupational Standards
This unit addresses the unit of competency: Understand Fundamentals of Programming

Duration of Unit: 180 hours

Unit Description
This unit covers the competencies required to understand fundamentals of programming. It involves understanding programming concepts, understanding the Java environment, performing data operations, using control structures, using methods and understanding Object Oriented programming.

Summary of Learning Outcomes:

1. Understand Programming Concepts
2. Understand the Java environment
3. Perform Data Operations
4. Use Control Structures
5. Use Methods
6. Understand Object Oriented Programming

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand Programming Concepts	• Definition of programming
	• Phases of program development
	  ◦ Establish program requirements
	  ◦ Design a program
	  ◦ Coding
	  ◦ Code test and debug
	  ◦ Document
	  ◦ Maintain
	• Key terms used in programming
	  ◦ Algorithm
	  ◦ Source code
	  ◦ Executable
	  ◦ Compiling
	  ◦ Debugging
		• Practical tests
		• Oral tests
		• Written tests

	• Types of code
	  • Source code
	  • Object code
	  • Machine code
	• Translators used in programming
	  • Compiler
	  • Interpreter
	  • Assembler
	• OOP fundamental concepts	

2. Understand the Java Environment	• Installation of Java
	  • Download Java for Windows
	  • Install JDK
	  • Set the Environment variables
	• Java Programming environment
	  • Downloading Eclipse IDE
	  • Setting up Eclipse IDE
	  • Launching Eclipse IDE
	• Features of Java
	• Java syntax
	  • Case Sensitivity
	  • Class names
	  • Method names
	  • Program file name
	  • Public static void main
	  • Identifiers
	  • Modifiers
	  • Variables
	  • Java Arrays
	  • Java Enums
	  • Java Keywords
		• Practical tests
		• Oral tests
		• Written tests

3. Perform Data Operations	• Java Data Types
	  • Integer
	  • Float
	  • Strings
	  • Boolean
	• Java statements
	  • Expression Statements
	  • Declaration Statements
		• Practical tests
		• Oral tests
		• Written tests

	• Control-flow statements
	• Variables and Constants
	  • Local Variables
	  • Class Variables
	  • Instance Variables
	  • Integer constants
	  • Real Constants
	  • Single character constants
	  • String constants
	• Java Data operations
	  • Variable assignment
	  • Variable reading
	  • Variable arithmetic
	  • Object Instantiation
	• Java Program to perform an operation
	  • Area of a circle
	  • Solve Quadratic equations
	  • Calculate compound interest	

4. Use Control structure	• Java Control Statements
	  • Decision making statements
	  • Looping statements
	  • Branching statements
	• Uses of different control statements in Java
	Decision making statements
	  • If then
	  • If then else
	  • Switch
	Looping statements
	  • for
	  • while
	  • do while
	Branching statements
	  • break
	  • Continue
	• Creation of programs using control statements
		• Practical tests
		• Oral tests
		• Written tests

5. Use Methods	• Java Methods
	  • Definition
	  • Structure
	• Demonstration of methods
	  • Creating Methods
	  • Method calling
	  • Void keyword
	  • Passing parameters by value
	  • Method overloading
	  • Using command line arguments
	  • The this keyword
	  • Variable arguments
	  • The finalize () method
	• Creation programs to implement methods
		• Practical tests
		• Oral tests
		• Written tests

6. Understand Object Oriented Programming	• Object oriented programming concepts
	  • Inheritance
	  • Encapsulation
	  • Abstraction
	  • Polymorphism
	• Classes
	  • Declaring attributes
	  • Creating Methods
	• Objects
	  • Creating objects
	  • Calling methods
	• Creation of programs to implement inheritance
		• 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;
- Visiting lecturer/expert from the ICT sector;
- Industrial visits.

Recommended Resources

Tools

- JDK

Equipment

- Computers

Materials and supplies

- Instructional materials
- Stationery

Reference materials

- Trainer-recommended resources including web resources

DATABASE MANAGEMENT SKILLS

UNIT CODE: ICT/CU/CS/CR/05/6/B

Relationship to Occupational Standards
This unit addresses the unit of competency: Understand Database Management Skills

Duration of Unit: 160 hours

Unit Description:
This unit covers the competencies required to demonstrate database management skills. It involves understanding database fundamentals, designing a database, using Structured Query Language, understanding design of object oriented databases, understanding indexing and hashing and understanding database applications.

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

1. Understand Database fundamentals
2. Design a database
3. Use Structured Query Language
4. Understand the design of object oriented databases
5. Understand indexing and hashing
6. Understand database applications

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand database fundamentals	• Definition of database
	• Database terminologies
	  ◦ Table
	  ◦ Database engine
	  ◦ Records
	  ◦ Field
	• Reasons of using databases
	• Definition of relational model
	• Relational Modelling Concepts
	  ◦ Relations/tables
	  ◦ Attributes/Columns
	  ◦ Domain
	  ◦ Tuples/Rows
	  ◦ Primary Key
	  ◦ Foreign Key
		• Oral tests
		• Written tests
		• Practical tests

	• Properties of a relation/table
	• Comparison of RDBMS products
	  • Oracle
	  • MS SQL server
	  • My SQL
	  • Ms Access
	• Installation of MS SQL server
	• MS SQL server interface
	• Properties of MS SQL server Database
	• Prescribe RDBMS product for a simulated environment
	• Database security
	  • Definition
	  • Access control
	  • Authentication
	  • Integrity control
	  • Backup	

2. Design a database	• Phases of database Design
	  • Conceptual database design (ERM Modeling)
	  • Logical database design
	  • Physical database design
	• Entity modelling
	  ✓ Components
	  ✓ Designing Entity Model using UML (Unified Modelling Language)
	• Normalisation
	  • Definition
	  • Demonstration of normalisation
	• Validating model according to the requirements / specified transactions (CRUD matrix)
		• Oral tests
		• Written tests
		• Practical tests

3. Use Structured Query Language (SQL)	• SQL
	  • Definition
	  • Characteristics
	  • Components
	• Data definition queries
	  • CREATE
		• Practical tests
		• Oral tests
		• Written tests

	• DROP • ALTER • Demonstration of CREATE TABLE statement • Demonstration of CREATE TABLE constraints: • PRIMARY KEY • FOREIGN KEY • NOT NULL • CHECK • UNIQUE • DEFAULT • Editing table schema using SQL ALTER statement • Adding an attribute • Dropping an attribute • Modifying attribute domain • Dropping table using SQL DROP TABLE statement • 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 • Create and query a database from a validated ER model. • Creating a simple join	

4. Understand design of object oriented databases	• Object oriented database
	  • Definition
	  • Comparison with other types of databases
	• Object oriented database concepts
	  • Classes
	  • Objects
	  • Attributes
	  • Inheritance
	• Implementation of Object Oriented Database Concepts from a set of requirements
	• Creation of views and triggers.
		• Practical tests
		• Oral
		• Written tests

5. Understand indexing and hashing	• Indexing and hashing
	  • Definition of indexing and hashing
	  • Types of indexing
	  • Types of hashing
	• Demonstration of indexing
	  • Dense index
	  • Sparse index
	• Demonstration of hashing
	  • Static hashing
	  • Dynamic hashing
	• Implementation of indexing and hashing in an existing database
		• Practical tests
		• Oral
		• Written tests

6. Understand database applications	• Decision support system • Data mining • Features of Distributed Databases • Features of Data warehouses • Features of Spatial and geographical databases • Features of Multi-media databases • Mobility and personal databases • Design and implementation of data warehouses	• 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 practical database design and SQL projects
- Visiting expert from the ICT sector;
- Industrial visits

Recommended Resources

Tools

- Microsoft Office with MS Visio Modelling tool

MS SQL server software

Equipment

- Computers

Materials and supplies

- Instructional material
- Stationery

Reference materials

- Trainer – recommended resources including web resources
- SQL Server technical documentation

INFORMATION SYSTEMS

UNIT CODE: ICT/CU/CS/CR/06/6/B

Relationship to Occupational Standards
This unit addresses the unit of competency: Develop an Information System

Duration of Unit:150 hours

Unit Description
This unit covers the competencies required to develop an information system. It involves understanding fundamentals of information systems, applying security measures to data, hardware, software in automated environment, understanding the software development process, demonstrating human computer interaction principles, understanding the VB.net programming environment and developing and testing a VB.NET application.

Summary of Learning Outcomes

1. Understand fundamentals of Information Systems
2. Apply security measures to data, hardware, software in automated environment
3. Understand the Software Development Process
4. Demonstrate Human Computer Interaction Principles
5. Understand the VB.NET programming environment
6. Develop and test a VB.NET application

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand fundamentals of Information Systems	• Information systems
	  • Definition
	  • Components
	• Types of information systems
	  • Transaction Processing Systems
	  • Management Information Systems
	  • Decision Support Systems
	  • Executive Information Systems
	  • Office Automation Systems
	• Emerging trends in information systems
		• Oral questioning
		• Written tests
		• Practical tests

	• Recommendation of information systems for different scenarios
	• Information system security
	  • Definition
	  • Information security management system
	  • Tools for information system security
	  • Firewalls
	  • Virtual private networks
	• Mobile security
	  • Geolocation software
	  • Remote data removal software
	• Web security
	  • Cyber security
	  • Technologies
	  • Web threats
	  • Defence strategies	

2. 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 questioning • Project • Practical tests

3. Understand the Software Development Process	• Software Development Life Cycle
	• Software Development Methodologies
	  • Waterfall
	  • Spiral
	  • Rapid Application Development
	  • Agile Development
	• Modeling techniques
	  • Data Flow Diagrams
	  • Entity Relation Diagrams
	  • UML diagrams
		• Written tests
		• Oral questioning
		• Practical tests

	• Creation of models for given scenarios	

4. Demonstrate Human Computer Interaction Principles	• Human Computer Interaction
	  • Definition
	  • Role of interaction design
	  • Interaction styles
	  • Interaction elements
	  • Mistakes in interaction design
	• Interface design principles
	• Prescribing interaction choices and recognition of interaction flaws
		• Practical
		• Oral questioning
		• Observation
		• Written tests

5. Understand the VB.NET programming environment	• The .Net framework
	  •Applications supported
	  •Components of the .Net framework
	• Installation of Visual Studio
	• Features of VB.Net
	• The Integrated Development Environment (IDE)
	  •Definition of IDE
	  •Parts of VB.Net IDE
	• VB.Net program structure
	  • VB.NET syntax
	  • Namespace declaration
	  • Class or module
	  • Procedures
	  • Data types, variables, constants
	  • The Main procedure
	  • Statements and Expressions (Variable declarations, operations, control statements)
	  • Comments
	• Creating aVB.Net project
	  • Saving Forms and Project
	  • Compiling a Project
		• Practical tests
		• Oral tests
		• Written tests

6. Develop and test a VB.NET application	• Basic VB.Net Controls • Controls and their purpose	• Practical tests • Oral tests

	• Standard naming conventions for controls
	• Elements of a control
	  • Properties
	  • Methods
	  • Events
	• Demonstrating Properties, Methods and Events
	  • Properties for basic controls
	  • Setting properties at design time and run time
	  • Methods for basic controls
	  • Events for basic controls
	• Demonstrating event handling
	  • Mouse events
	  • Keyboard events
	• Designing VB.NET form using HCI principles
	• Connection of VB.Net applications to a database
	  • ADO.Net object model
	  • Demonstrating Database connection using the Data Provider
	  • Demonstrating creation of tables using Dataset components
	• Deployment of VB.NET VB.Net applications
	  • Purpose deployment
	  • Demonstrating deployment steps
		• 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;
- Visiting expert from the ICT sector;
- Industrial visits

Recommended Resources

Tools

- Visual Studio, CASE software, UX/UI software

Equipment

- Computer

Materials and supplies

- Instructional materials
- Stationery

Reference materials

- Trainer-recommended resources including web resources
- Visual Studio Documentation

NETWORKING AND DISTRIBUTED SYSTEMS

UNIT CODE:ICT/CU/CS/CR/07/6/B

Relationship to Occupational Standards

This unit addresses the unit of competency: Understand Networking and Distributed Systems

Duration of Unit: 210 hours

Unit description:

This unit specifies the competencies required to understanding networking and distributed systems concept. It involves understanding networking and distributed systems, distributed system architectures, distributed processing and file management, setting up a network in a distributed environment understanding data communication standards and IP addressing and troubleshooting a network.

Summary of Learning Outcomes

1. Understand networking and distributed systems
2. Understand distributed systems architectures
3. Understand distributed processing and file management
4. Set up a network in a distributed environment
5. Understand Data Communication Standards and IP addressing
6. Troubleshoot a network

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand networking and distributed systems concepts	• Fundamentals of networking
	  • Definition of network
	  • Definition of network terminologies
	  • Identified network components
	  • Application and benefits of networking
	• Types of networks
	  • LAN
	  • MAN
	  • WAN
	  • PAN
	• Network topologies
		• Written tests
		• Observation
		• Oral tests
		• Practical tests

	• Star
	• Ring
	• Mesh
	• Bus
	• Transmission media
	  • Wired media
	  • Wireless media
	• Distributed system
	  • Definition
	  • Application
	• Types of distributed systems
	  • Computing
	  • Information
	  • Pervasive
	  • Client server
	  • Peer to peer
	• Distributed systems models
	  • Architectural
	  • Interaction
	  • Fault
	• Specifying network requirements for a site
	  • Type of network
	  • Type of topology
	  • Devices
	• Network security
	  • Definition
	  • Types of network attacks
	  • Active
	  • Passive
	• Components of network security
	  • Network access control
	  • Firewall
	  • Intrusion prevention
	  • Security information and event management
	• Wireless security	

2. Understand distributed systems architectures	• Distributed architecture
	  • Definition
	  • Application
	• Architecture styles
		• Written tests
		• Observation
		• Oral tests
		• Practical tests

	• Layered Architecture • Object Based Architecture • Data-centred Architecture • Types of distributed system architectures • Centralized • Decentralized • Hybrid • Specifying distributed system architecture requirements for a simulated site • Architecture style • Type of distributed system architectures	
3. Understand distributed processing and file management	• Types of distributed processing • Distributed processing • Parallel processing • Types of file systems • File sharing and accessing methods • Remote access • Data caching • Demonstration of distributed file sharing and access	• Written tests • Observation • Oral tests • Practical tests
4. Set up a network in a distributed environment	• Selection of tools, materials and devices • Connection and configuration of network devices • Installation and configuration of network software • Testing the network	• Written tests • Observation • Oral tests • Practical tests
5. Understand Data Communication standards and IP addressing	• OSI model • Definition • Functions of different OSI model layers • OSI layer Protocols are illustrated • Data communication components • Message • Sender	

	• Receiver
	• Medium
	• Protocol
	• Network IP Address classes
	  • Class A, B, C
	  • Public and Private IP Address
	  • Automatic Private IP Address	

6. Troubleshoot a network	• Troubleshooting
	  • Definition
	  • Techniques
	  • Procedures
	• Troubleshooting tools
	  • Ping
	  • Tracert/traceroute
	  • Nslookup
	  • Netstat
	  • Pathping/mtr
	• Demonstration of network troubleshooting as per IEEE standard
		• Written tests
		• Observation
		• Oral tests
		• Practical 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 site;
- Visiting lecturer/trainer from the ICT sector;
- Industrial visits.

Recommended Resources

Tools

- Network tool kit
- Signal testers
- Spam Blacklists
- URL Encode
- Header checker
- LanTEK III cable certifier
- Crimpers (RJ45, Hex Coax)
- Punch Down Tools.
- Wire Strippers & Cutters.

- Network Testers.
- Tone & Probes.
- Cable Installation Tools.
- Coaxial & RG6 Tools.

Equipment

- Computer
- Switches
- Routers
- Modem
- Bridges
- Repeaters
- Fibre modules
- Gateways

Materials and supplies

- Hand cleaner.

Reference materials

- Manufacturers service manuals for Network equipment
- Trainer-recommended resources including web resources

ARTIFICIAL INTELLIGENCE

UNIT CODE: ICT/CU/CS/CR/08/6/B

Relationship to Occupational Standards

This unit addresses the unit of competency: Understand Artificial Intelligence

Duration of Unit: 180 hours

Unit Description

This unit covers the competencies required to understand artificial intelligence. It involves understanding fundamentals of Artificial Intelligence, understanding problem solving techniques, understanding Python programming environment and developing Artificial Intelligence programs using Python.

Summary of Learning Outcomes

1. Understand Artificial Intelligence fundamentals.
2. Understand problem solving techniques.
3. Understand Python programming environment.
4. Develop Artificial Intelligence programs using Python.

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand concepts of Artificial Intelligence	• Definition of Artificial Intelligence
	• History of Artificial Intelligence
	• Foundations of Artificial Intelligence
	  • Mathematics
	  • Economics
	  • Decision Theory
	  • Neurology
	  • Engineering
	  • Psychology
	  • Computer Networking
	• Applications of Artificial Intelligence
	  • Expert systems
	  • Machine Learning
	  • Natural Language Processing
	  • Gaming
		• Oral tests
		• Written tests
		• Practical tests

	• Artificial Neural Networks • Computer Vison • Intelligence agents • Recognising Artificial Intelligence applications in real life	
2. Understand problem solving techniques	• Logical operators • AND • OR • NOT • Prepositional Logic and Predicate logic • Types of inferencing • Single Inferencing • Multiple inferencing • Case based reasoning • Definition of Machine Learning • Types of Machine Learning • Supervised Machine Learning • Unsupervised Machine Learning • Recognising applications of different types of inferencing	• Oral tests • Written tests • Practical tests
3. Understand Python programming environment	• Installation of Python • Downloading Python Set Up • Running Python Set Up • Python syntax • The Zen of Python • Python Enhancement Proposals 8 (PEP 8) • Variable declaration. • Commenting • Python data types • Integer • Float • Boolean • Set • Dictionary	• Oral tests • Written tests • Practical tests

	• Tuple • List • String • Control structures in Python • Selection • Looping • Functions in Python • Built-in functions • User defined functions • Lambda functions • Object Oriented Python • Creation of classes • Class variables • Class methods • Scientific Modules in Python • Pandas • Numpy • Matplotlib • Creation of programs using Scientific Modules	
4. Develop Artificial Intelligence programs using python	• Sci-Kit Learn • Machine Learning with K-Nearest Neighbours • Mathematics behind K-Nearest Neighbours • Making Predictions with K-Nearest Neighbours • Machine Learning with Naïve Bayes Algorithm • Mathematics behind Naïve Bayes Algorithm • Making predictions with Naïve Bayes Algorithm • Creation of AI programs using Machine learning	• 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
- Visiting lecturer/trainer from the Computer Science sector;
- Industrial visits.

Recommended Resources

Tools

- Python IDE

Equipment

- Computer

Materials and supplies

- Video tutorials
- Instructional materials
- Stationery

Reference materials

- Python Programming text books
- Official Python website

ALGORITHMS AND DATA STRUCTURES

UNIT CODE: ICT/CU/CS/CR/09/6/B

Relationship to Occupational Standards

This unit addresses the unit of competency: Understand Algorithms and Data Structures

Duration of Unit: 170 hours

Unit Description

This unit covers the competencies required to understand algorithms and data structure. It involves Understand fundamental principles of algorithms understanding fundamental concepts of data structures, linked lists, stacks and queues, search techniques and sorting techniques

Summary of Learning Outcomes

1. Understand fundamental principles of algorithms
2. Understand fundamental concepts of data structures
3. Understand linked lists
4. Understand stacks and queues
5. Understand search techniques
6. Understand sorting techniques

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Method

1. Understand Fundamental principles of algorithms	• Definition of an Algorithm
	• Characteristics of an Algorithm
	• Principles of algorithm writing
	• Algorithm Analysis
	• Complexities of algorithms
	  • Space
	  • Time
	• Greedy algorithms are outlined
	  • Counting coins
	• Divide and conquer algorithms
	  • Divide /break
	  • Conquer/solve
	  • Merge/combine
		• Written tests
		• Oral tests
		• Practical tests

2. Understand fundamental	• Key concepts in data structures
	  • Data
	  • Object
		• Written tests
		• Oral tests
		• Practical tests

concepts of data structures	• Data type
	• Explanation of Arrays
	• Array insertion operations
	  • At the beginning
	  • At the given index
	  • After the given index
	  • Before the given index
	• Array delete, search and update
	• Demonstration of array operations	

3. Understand Linked lists	• Linked lists
	  • Linked lists representation
	  • Types of linked lists
	• Doubly linked lists
	  • Representation
	  • Basic operations
	• Circular linked lists
	  • Representation
	  • Basic operations
	• Demonstration of basic operations for the various linked lists using Java
	  • Insertion
	  • Deletion
	  • Reverse
	  • Display
		• Written tests
		• Oral tests
		• Practical tests

4. Understand Stacks and Queues	• Definition of Stacks
	• Representation of stacks
	• Basic operations
	  • Pop
	  • Push
	• Definition of queues
	• Representation of queues
	• Basic operations
	  • Enqueue
	  • Dequeue
	• Demonstration of stack and queues using Java
		• Written tests
		• Oral tests
		• Practical tests

5. Understand Search Techniques	• Definition of search • Explanation of Linear Search • Explanation of Binary Search	• Written tests • Oral tests • Practical tests

	• Demonstration of linear search and binary search using Java	

6. Understand Sorting Techniques	• Definition of Sorting
	• Categories of sorting
	  • Stable and not stable sorting
	  • Adaptive and Non-Adaptive Sorting Algorithm
	  • In place and not in place
	• Types of Sorting algorithms
	  • Bubble sort
	  • Insertion sort
	  • Selection sort
	• Demonstration of sorting algorithms using Java
		• Written tests
		• Oral tests
		• Practical tests

Suggested Methods of Instruction

- Presentations by trainer;
- Guided learner activities and research to develop underpinning knowledge;
- Supervised practical assignments
- Visiting expert from the ICT sector;
- Industrial visits

Recommended Resources

Tools

- JDK

Equipment

- Computers

Materials and supplies

- Instructional materials
- Stationery

Reference materials

- Trainer recommended resources including web resources

WEB DESIGN SKILLS

UNIT CODE: ICT/CU/CS/CR/10/6/B

Relationship to Occupational Standards

This unit addresses the unit of competency**:** Demonstrate Web Design Skills

Duration of Unit: 200 hours

Unit Description:
This unit covers the competencies required to demonstrate web design skills. It involves understanding HTML basics, using HTML elements, demonstrating web page formatting, applying styles, understanding JavaScript basics, using JavaScript data types, using JavaScript functions and using JavaScript libraries.

Summary of Learning Outcomes:

1. Understand HTML basics
2. Use HTML elements
3. Demonstrate web page formatting
4. Apply styles
5. Understand JavaScript basics
6. Use JavaScript data types
7. Use JavaScript functions
8. Use JavaScript libraries

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Method

1. Understand HTML basics	• Definition of HTML
	• HTML terminologies
	  ◦ Document
	  ◦ Stylesheet
	  ◦ Element
	  ◦ Attribute
	• Creation of HTML file
	  ◦ Document type declaration
	  ◦ Saving as .html file
	• HTML core elements
	  ◦ <head>
	  ◦ <title>
	  ◦ <body>
		• Practical tests
		• Written tests
		• Oral tests

	• <html> • Addition of HTML core elements to file	

2. Use HTML elements	• Basic HTML elements
	  • <p>
	  •
	
	  • <h1>
	• Addition of basic HTML elements to HTML document
	• Definition of attributes
	  • src
	  • alt
	  • href
	• Addition of attributes to elements
		• Practical tests
		• Written tests
		• Oral tests

3. Demonstrate web page formatting	• Layout elements
	  • <header>
	  • <nav>
	  • <section>
	  • <footer>
	• Addition of layout elements to HTML document
	• Addition of layout element attributes to HTML document
	  • class
	  • id
	  • name
		• Practical tests
		• Written tests
		• Oral tests

4. Apply Styles	• Style concepts
	  • background
	  • padding
	  • alignment
	  • border
	• Application of internal styles
	• Creation of external CSS file
		• Practical tests
		• Written tests
		• Oral tests

5. Understand JavaScript basics	• Purpose of JavaScript • JavaScript syntax • Accessing HTML element attributes using the JavaScript Document Object Model (DOM) • Changing HTML element attributes using JavaScript DOM model	• Practical tests • Written tests • Oral tests

6. Use JavaScript data types	• JavaScript data types
	  • Strings
	  • Numbers
	  • Booleans
	• Demonstration of data type operations
	  • Variables declarations and scope
	  • Expressions
	  • Arithmetic
	  • Boolean
	  • String concatenation
	• Demonstration on arrays operations
	  • count ()
	  • pop ()
	  • push()
		• Practical tests
		• Written tests
		• Oral tests

7. Use JavaScript functions	• JavaScript function structure • Creation of JavaScript function • Invoking of JavaScript function • Returning values from functions	• Practical tests • Written tests • Oral tests

8. Use JavaScript libraries	• Libraries concept
	• JQuery framework
	• Installation of JQuery
	• Referencing JQuery
	• JQuery syntax
	• JQuery events
	  • Keyboard
	  • Mouse
	  • Form
	  • Document Window
	• DOM manipulation with JQuery
		• 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

- Text Editor

- Browser

Equipment

- Computer

Materials and supplies

- Instructional materials
- Stationery

Reference materials

- Trainer-recommended resources including web resources

GRAPHIC DESIGN

UNIT CODE: ICT/CU/CS/CR/11/6/B

Relationship to Occupational Standards

This unit addresses the unit of competency: Understand Graphic Design

Duration of Unit: 170 hours

Unit description:

This unit covers the competencies required to understand Graphic Design. It involves understanding fundamentals of graphic design, understanding elements and principles of graphic design, applying typography techniques, creating and editing of images, performing layout design and printing the design.

Summary of Learning Outcomes

1. Understand graphic design fundamentals
2. Understand elements and principles of graphic design
3. Apply typography techniques
4. Create and edit images
5. Perform layout design
6. Print design.

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Understand graphic design fundamentals	• Graphic Design
	  • Definition
	  • Types of elements
	  • Principles
	  • Application areas
	• Graphic design equipment
	  • Computer
	  • Scanner
	  • Printer
	  • Camera
	  • Digital Tablet
	• Uses of graphic design
	• Specified requirements as per user requirements
		• Written tests
		• Observation
		• Oral tests
		• Practical tests

2. Understand elements and principles of graphic design	• Demonstration of elements
	  • Colour
	  • Line
	  • Space
	  • Shape
	  • Texture
	  • Value
	• Principles of graphic design
	  • Balance
	  • Contrast
	  • Emphasis
	  • Harmony
	  • Pattern
	  • Proportion
	  • Unity
	• Selected appropriate elements for graphic design project
		• Written tests
		• Observation
		• Oral tests
		• Practical tests

3. Apply typography techniques	• Typography techniques
	  • Definition
	  • Types of techniques
	• Typography guidelines
	• Measurements and standards
	• Selecting an appropriate typography techniques for graphic design project
		• Written tests
		• Observation
		• Oral tests
		• Practical tests

4. Create and edit images	• Identification of graphic design and photography Software and tools
	• Image file types
	  • Raster
	  • Vector
	• Creation of letter forms, lines of type and body copy
	• Creation and manipulation of images
		• Written tests
		• Observation
		• Oral tests
		• Practical tests

5. Perform layout design	• Proportion on layout design • Creation of unified systems out of dissimilar elements • Creation of dynamic layouts using typographic tools	• Written tests • Observation • Oral tests • Practical tests

	• Creation of Type and image project • Multi-page layout planning	

6. Print design	• Printing tools and Equipment
	• Types of printing
	• Paper classification
	  • Types
	  • Size
	  • Weight
	• Selection of printing chemicals
	• Demonstration of actual design printing
		• Written tests
		• Observation
		• 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 activities and projects
- Visiting lecturer/trainer from the ICT sector;
- Industrial visits.

Recommended Resources

Tools

- Microsoft Publisher
- Illustrator
- Adobe InDesign
- Adobe Photoshop
- Paint.net
- Corel Draw

Equipment

- Computers
- Printers
- Scanners
- Camera
- Digital Tablet

Reference materials

- Digital instructional material including DVDs and CDs