NATIONAL SKILLS QUALIFICATION

LEVEL 3

TITLE:

ROBOTICS

YEAR:

2024

NATIONAL SKILLS QUALIFICATION

NSQ LEVEL 3 - ROBOTICS

GENERAL INFORMATION

QUALIFICATION PURPOSE

This qualification is designed to equip learners with the foundational skills and knowledge needed to design, develop, operate, maintain, and troubleshoot basic robotic systems in industrial and technological environment.

QUALIFICATION OBJECTIVES

The learner should be able to: -

i. Understand basic robotics concepts
ii. Acquire experience in using development Boards (e.g., Unity Board, Arduino, ESP32)
iii. Learn embedded programming
iv. Build basic robotic projects
v. Program a robot using embedded programming
vi. Develop problem-solving and critical-thinking skills

Mandatory Units

Unit No	Reference Number	NOS Title	Credit Value	Guided Learning Hours	Remark
Unit 001	ICT/GSS/001/L3	Occupational Health and Safety	1	10	*Mandatory*
Unit 002	ICT/GSS/002/L3	Teamwork	1	10	*Mandatory*
Unit 003	ICT/GSS/003/L3	Communication	1	10	*Mandatory*
Unit 004	ICT/RBT/004/L3	Introduction to robotics	2	20	*Mandatory*
Unit 005	ICT//RBT/005/L3	Basic electronics for robotics	2	20	*Mandatory*
Unit 006	ICT/ RBT/006/L3	Sensors and input in robotics	2	20	*Mandatory*
Unit 007	ICT/ RBT/007/L3	Motors and actuators	2	20	*Mandatory*
Unit 008	ICT/ RBT/008/L3	Building a basic robot	3	30	*Mandatory*
Unit 009	ICT/ RBT/009/L3	Programming your robot	3	30	*Mandatory*
Unit 010	ICT/ RBT/010/L3	Advanced features-servo motors and remote control	2	20	*Mandatory*

NOTE:

1. *All units in this certification are mandatory to equip learners with sufficient knowledge of IT. This is a 20 credits unit course requiring a minimum of 200 guided learning hours.*
2. *Training centers are at liberty to train using any of the relevant programming languages and report assessment processes followed during training to the awarding body for certification purposes.*

NATIONAL SKILLS QUALIFICATION

LEVEL 3: *Robotics*

Unit 001: OCUPATIONAL HEALTH AND SAFETY

Unit Reference Number: ICT/GSS/001/L3

NSQ Level: 3

Credit Value: 1

Guided Learning Hours: 10

Unit Purpose:

To equip learners with the knowledge and skills to implement and maintain safe working practices in the IT environment, ensuring personal and team safety while adhering to industry regulations and standards.

Unit assessment requirements/ evidence requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out.

Assessment methods to be used include:

1. Direct Observation/oral questions (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Assignment (ASS), etc.

UNIT 001: Occupational Health and Safety

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Understand Workplace Health and Safety Regulations	1.1	Explain key OHS legislation and regulations relevant to the IT sector.									
	1.2	Identify the roles and responsibilities of individuals and organizations in maintaining a safe work environment									
	1.3	Describe the process for reporting health and safety risks and incidents.									
LO 2: Identify Workplace Hazards and Implement Control Measures	2.1	Identify common hazards in IT work environments, including electrical, ergonomic, and data-related risks									
	2.2	Assess the severity and likelihood of potential hazards in specific IT tasks.									
	2.3	Implement appropriate control measures, such as safe cabling practices, ergonomic workstation setup, and electrical safety protocols.									
LO 3: Apply Emergency Procedures and First Aid in the Workplace	3.1	Demonstrate the correct procedure for responding to workplace emergencies, such as electrical fires or equipment malfunctions.									
	3.2	Perform basic first aid techniques, including treating minor injuries and using first aid equipment									
	3.3	Communicate and coordinate effectively with emergency services and other relevant personnel during a workplace incident.									

Learner's Signature	Date
Assessor's Signature	Date
IQA's Signature	Date
EQA's Signature	Date

Unit 002: Teamwork

Unit Reference Number: ICT/GSS/002/L3

NSQ Level: 3

Credit Value: 1

Guided Learning Hours: 10

Unit Purpose:

To develop learners' abilities to work effectively within IT teams, fostering collaboration, problem-solving, and the achievement of shared goals.

Unit assessment requirements/ evidence requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out.

Assessment methods to be used include:

1. Direct Observation/oral questions (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Assignment (ASS), etc.

UNIT 002: Teamwork

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Understand the Roles and Responsibilities within a Team	1.1	Identify the different roles and functions within an IT team (e.g., network engineers, system administrators, software developers).									
	1.2	Describe the key responsibilities and contributions of each team member.									
	1.3	Recognize the importance of each role in achieving the team's objectives.									
LO 2: Foster Positive Working Relationships within a Team	2.1	Demonstrate techniques for effective interpersonal communication and conflict resolution in a team environment.									
	2.2	Show the ability to provide constructive feedback and actively listen to others' contributions									
	2.3	Promote inclusivity and collaboration among team members to ensure participation and engagement from all.									
LO 3: Contribute to Team Problem-Solving and Decision-Making	3.1	Participate in group discussions to identify and analyse IT-related problems.									
	3.2	Suggest innovative solutions and support team decision-making processes.									
	3.3	Evaluate the effectiveness of team decisions and propose improvements where necessary.									

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Unit 003: Communication

Unit Reference Number: ICT/GSS/003/L3

NSQ Level: 3

Credit Value: 1

Guided Learning Hours: 10

Unit Purpose:

To enhance learners' communication skills, enabling them to convey technical information effectively and collaborate with both technical and non-technical stakeholders.

Unit assessment requirements/ evidence requirements:

Assessment must be carried out in real workplace environment in which learning and human development is carried out.

Assessment methods to be used include:

1. Direct Observation/oral questions (DO)
2. Question and Answer (QA)
3. Witness Testimony (WT)
4. Assignment (ASS), etc.

UNIT 003: Communication

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Communicate Technical Information Clearly and Accurately	1.1	Explain IT concepts, procedures, and solutions in a manner appropriate to the audience, whether technical or non-technical.									
	1.2	Use industry-standard terminology correctly when describing technical processes									
	1.3	Adapt communication methods to suit the context, such as written reports, emails, or verbal presentations.									
LO 2: Utilize Digital Communication Tools Effectively	2.1	Demonstrate proficiency in using digital tools for communication, such as email, messaging platforms, and collaboration software (e.g., Slack, Teams).									
	2.2	Adhere to best practices for professional digital communication, including email etiquette and secure file sharing.									
	2.3	Use collaborative tools to share and receive feedback on documents, code, or project updates.									
LO 3: Listen and Respond Appropriately in a Professional Context	3.1	Demonstrate active listening skills during team discussions or client meetings.									
	3.2	Respond to questions, concerns, and feedback clearly and effectively.									
	3.3	Clarify misunderstandings and summarize discussions to ensure mutual understanding.									

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Unit 004: INTRODUCTION TO ROBOTICS

Unit Reference Number: ICT/RBT/004/L3

NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: This unit equips the learner with understanding of the foundational concepts in robotics and proficiency in utilizing Development Boards.

Assessment methods to be used include:

5. Multiple-choice questions (MCQ's)
6. Scenario-based questions
7. True/False Matching questions
8. Periodic checks within the course as (Quizzes)

UNIT 004: INTRODUCTION TO ROBOTICS

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Understanding Robotics and its application in today's technological landscape	1.1	Define Robotics									
	1.2	Explain applications of Robotics in Industry, Healthcare, etc.									
	1.3	Identify the components of a robot (Sensors, Actuators, Controllers)									
LO 2: Understand Unity Board (Arduino-Compatible)	2.1	Define Unity Board									
	2.2	Identify Features and technical specifications of Unity Board									
	2.3	Describe the components of the unity board and their functions									
LO 3: Understand the components of Integrated Development Environment (IDE)	3.1	Explain an IDE									
	3.2	Set up the IDE (installation)									
	3.3	Configure the Unity Board in an IDE									
	34	Upload First code (Blinking an LED)									

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Unit 005: BASIC ELECTRONICS FOR ROBOTICS

Unit Reference Number: ICT/RBT/005/L3

NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: *This unit ensures that learners are equipped with the foundational knowledge and practical skills necessary in electronics design.*

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Assessment methods to be used include:

1. Multiple-choice questions (MCQ's)
2. Scenario-based questions
3. Drag-and-Drop or Matching exercises
4. Diagram-based Questions (Quizzes)
5. Practical assessment (*where possible*)

UNIT 005: BASIC ELECTRONICS FOR ROBOTICS

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Understand Basic Electronics	1.1	Explain the basics of electronic Circuits (Voltage, Current, Resistance)									
	1.2	Read simple circuit diagrams									
	1.3	Work with Breadboards, LEDs, and other components									
LO 2: Build Simple Circuits with Unity Board	2.1	Connect LEDs to the Unity Board									
	2.2	Program basic LED control (Turn on/off, Blink)									
	2.3	Introduction to digital pins and analog signals									
LO 3: Understand Basic Circuit Design and Simulation	3.1	Explain circuit design									
	3.2	Perform Circuit Analysis									
	3.3	Use Proteus etc for circuit simulation									
	3.4	Design simple circuits (LED control, buzzer alarm)									

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Unit 006: SENSORS AND INPUT IN ROBOTICS

Unit Reference Number: ICT/RBT/006/L3
NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: *This unit ensures that learners acquire a thorough understanding of various sensors and input mechanisms used in robotics, equipping them with the skills to integrate and utilize these sensors effectively in robotic systems to enhance functionality and responsiveness in applications.*

Assessment methods to be used include:

1. Multiple-choice questions (MCQ's)
2. Scenario-based questions
3. Hands-on tasks

UNIT 006: SENSORS AND INPUT IN ROBOTICS

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Understand Sensors and Types of Sensors in Robotics	1.1	Identify common sensors: Ultrasonic, Infrared, and others									
	1.2	Explain applications and benefits of each sensor type in robotics									
	1.3	Perform comparative analysis of sensor functionalities and use cases									
LO 2: Know how Sensors Work	2.1	Explain basic principles of sensor operation (input and output mechanisms)									
	2.2	Program the sensor									
	2.3	Identify the interfaces between sensors and robots									
LO 3: know Sensor Integration in Robotics	3.1	Perform typical sensor integration scenarios in robotic system									
	3.2	Identify challenges and solutions in sensor integration									
	3.3	Design a prototype with sensors in robots									

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Unit 007: MOTORS AND ACTUATORS

Unit Reference Number: ICT/RBT/007/L3

NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: *This unit ensures that learners develop a comprehensive understanding of motors and actuators in order to integrate and control these components effectively within robotic systems to achieve precise movement and operation.*

Assessment methods to be used include:

1) Multiple-choice questions (MCQ's)
2) Scenario-based questions
3) Drag-and-Drop or Matching exercises
4) Diagram-based Questions (Quizzes)
5) Practical assessment (*where possible*)

UNIT 007: MOTORS AND ACTUATORS

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.				
LO 1: Know Motors used in Robotics	1.1	Identify Types of Motors (DC Motors, Servo Motors)										
	1.2	Explain Working Principles of Motors										
	1.3	Identify motors for Robotics applications										
LO 2: Know how to Control Motors with Unity Board	2.1	Control a DC motor with Unity Board (Arduino-compatible)										
	2.2	Program Motor Speed and Direction with a suitable program										
	2.3	Implement Pulse Width Modulation (PWM) with the board.										
LO 3: Know Advanced Motor and Actuator Control	3.1	Integrate Actuators with Motors										
	3.2	Perform control strategies										
	3.3	Perform troubleshooting and maintenance										

Learner's Signature	Date
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Unit 008: BUILDING A BASIC ROBOT

Unit Reference Number: ICT/RBT/008/L3
NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: *This unit ensures that learners acquire the foundational mechanical, electrical and programming skills and knowledge required to design, assemble, and program a basic robot.*

Assessment methods to be used include:

1. Multiple-choice questions (MCQ's)
2. Scenario-based questions
3. Drag-and-Drop or Matching exercises
4. Diagram-based Questions (Quizzes)
5. Practical assessment (*where possible*)

UNIT 008: BUILDING A BASIC ROBOT

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Know basic robot design	1.1	Explain what it takes to Design a Basic Robot (chassis, wheels, motor placements)									
	1.2	Select Components for a Simple Robot									
	1.3	Plan robot movements									
	1.4	Design robot movements									
LO 2: Understand Assembling a Simple Robot	2.1	Assemble a Two-Wheeled Robot Using DC Motors									
	2.2	Connect Motors to the Unity Board									
	2.3	Test Motor Control with Basic Movement Programs									
LO 3: Know Testing and Optimization	3.1	Integrate a test system									
	3.2	Identify common sources of error									
	3.3	Debug errors found in 3.2									
	3.4	Identify potential improvements and additional features for future development									

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Unit 009: PROGRAMMING YOUR ROBOT

Unit Reference Number: ICT/RBT/009/L3

NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: *This unit ensures that learners gain a thorough understanding of programming principles and techniques specific to robotics.*

Assessment methods to be used include:

1) Multiple-choice questions (MCQ's)
2) Scenario-based questions
3) Drag-and-Drop or Matching exercises
4) Diagram-based Questions (Quizzes)
5) Practical assessment (*where possible*)

UNIT 009: PROGRAMMING YOUR ROBOT

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.				
LO 1: Know how to write a Robotic Program	1.1	Write Basic Movement Programs										
	1.2	Use Loops and Conditional Statements										
	1.3	Debug Basic Programs										
	1.4	Test Basic Programs										
LO 2: Know Programming Autonomous Movement	2.1	Write Programs for Autonomous Movement Using Sensor Input										
	2.2	Create Simple Obstacle-Avoiding Behavior Using Ultrasonic Sensors										
	2.3	Test Autonomous movements in robots										
	2.4	Calibrate robot movements for better performance										
LO 3: Know how to Enhance Robotic Programs	3.1	Add additional Behaviors										
	3.2	Integrate Advanced Sensors and Actuators										
	3.3	Do Final Testing.										

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Unit 010: ADVANCED FEATURE-SERVO MOTORS AND REMOTE CONTROL

Unit Reference Number: ICT/RBT/010/L3

NSQ Level: 3

Credit Value: 2

Guided Learning Hours: 20

Unit Purpose: *This unit ensures that learners acquire a fundamental understanding of servo motors and their applications for dynamic remote control in robotic systems.*

Assessment methods to be used include:

1. Multiple-choice questions (MCQ's)
2. Scenario-based questions
3. Drag-and-Drop or Matching exercises
4. Diagram-based Questions (Quizzes)
5. Practical assessment (*where possible*)

UNIT 010: ADVANCED FEATURES-SERVO MOTORS AND REMOTE CONTROL

LEARNING OBJECTIVE (LO) The learner will:		PERFORMANCE CRITERIA The learner can:	Evidence Type					Evidence Ref. Page No.			
LO 1: Understand Servo Motors	1.1	Identify types of servo motors									
	1.2	Explain Mechanisms and Applications **of** servo motors									
	1.3	Select servo motors based on specifications									
LO 2: Know how to Control Servo Motors	2.1	Explain servo motors control principles									
	2.2	Control servo motors by implementing 180-degree continuous rotation									
	2.3	Control Ultrasonic sensor with servo motor as a Radar system.									
LO 3: Know how to control a robot remotely	3.1	Control a robot using an IR Sensor and Remote									
	3.2	Program the Robot to Respond to Remote Commands									
	3.3	Integrate Wireless control features through Bluetooth or wifi.									

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Required Materials:

Development board such as Unity Board (Arduino-compatible)

USB Cable

Sensors (Ultrasonic sensor, IR sensor, etc.)

Actuators (DC motors, servos)

Jumper wires, breadboards, resistors, LEDs

Power supply (Battery)

Wheels and chassis (robot body)

Laptop/PC with IDE installed

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