**A lion with two spears and a rooster

Description automatically generated**

**REPUBLIC OF KENYA**

**COMPETENCY BASED MODULAR CURRICULUM**

**FOR**

**INDUSTRIAL AUTOMATION AND ROBOTICS OPERATIONS**

**KNQF LEVEL 4**

**PROGRAMME ISCED CODE: 0714 354A**

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FOREWORD

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

Reforms in the education sector are necessary to achieve Kenya Vision 2030 and meet the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution, and this resulted in the formulation of the Policy Framework for Reforming Education and Training in Kenya (Sessional Paper No. 14 of 2012). 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 the mode of delivery allow 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. For trainees to build their skills on foundational hands-on activities of the occupation, units of learning are grouped in modules. This has eliminated duplication of content and streamlined exemptions based on skills acquired as a trainee progresses in the up-skilling process, while at the same time allowing trainees to be employable in the shortest time possible through the acquisition of part qualifications.

It is my conviction that this curriculum will play a great role in developing competent human resources for the ………………… Sector’s growth and development.

**PRINCIPAL SECRETARY**

**STATE DEPARTMENT FOR TVET**

**MINISTRY OF EDUCATION**

**PREFACE**

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

TVET Act CAP 210A and Sessional Paper No. 1 of 2019 on Reforming Education and Training in Kenya for Sustainable Development 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 the Kenyan labour force.

This curriculum has been developed in adherence to the Kenya National Qualifications Framework and CBETA standards and guidelines. The curriculum is designed and organized into Units of Learning with Learning Outcomes, suggested delivery methods, learning resources, and methods of assessing the trainee’s achievement. In addition, the units of learning have been grouped in modules to concretize the skills acquisition process and streamline upskilling.

I am grateful to all expert trainers and everyone who played a role in translating the Occupational Standards into this competency-based modular curriculum.

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 were received from expert trainers, institutions and organizations.

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

I am convinced that this curriculum will go a long way in ensuring that individuals aspiring to work in the ……………… Sector acquire competencies to perform their work more efficiently and effectively.

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ABBREVIATIONS AND ACRONYMS

CAD Computer Aided Design

KP Kenya Power

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training

KEY TO ISCED UNIT CODE



# SUMMARY OF UNITS OF LEARNING

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Unit of Learning**  **Code** | **Unit**  **Category** | **UNIT NAME** | **DURATION**  **(Hours)** | **CREDIT FACTOR** |
|  | **MODULE ONE** | | | |
| 0714 351 01A | CORE | Industrial Automation and Robotic Systems Operations | 250 | 25.0 |
| 0714 351 03A | CORE | Product Quality Maintenance | 140 | 14.0 |
|  | **SUB TOTAL** | | 390 | 39.0 |
|  | **MODULE TWO** | | | |
| 0714 351 02A | CORE | Industrial Automation and Robotic Systems Maintenance | 220 | 22.0 |
|  | **SUB TOTAL** | | 220 | 22.0 |
|  | **INDUSTRIAL ATTATCHMENT** | | 320 | 32.0 |
|  | **GRAND TOTAL** | | **930 HRS** | 93.0 |

The total number of hours for this course is 930 hours

**Entry Requirements**

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

1. Kenya Certificate of Primary Education (KCPE)

**Or**

1. Equivalent qualifications as determined by TVETA

**Trainer Qualification**

Qualifications of a trainer for this course include:

1. Have a minimum of KNQF Level 5 qualification or its equivalent in a related trade area.
2. Be licensed by TVETA.

**Industry Training**

An individual enrolled in this course will be required to undergo Industry training for a minimum period of ……320… hours in … industrial automation and robotics …… sector. The industrial training may be taken after completion of all units for those pursuing the full qualification or be distributed equally in each unit for those pursuing part qualification. In the case of dual training model, industrial training shall be as guided by the dual training policy.

**Assessment**

The course shall be assessed formatively and summatively:

1. During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
2. During summative assessment basic and common units shall be integrated in the core units.
3. Summative assessment shall involve practical assessment focusing more on critical aspects of the respective unit of competency.
4. Theoretical and practical weight shall be 10:90 respectively for each unit of learning.
5. Theoretical (written/oral) assessment shall have formative and summative assessments weighted at 60% and 40% respectively in the overall unit of learning score
6. Assessment performance rating for each unit of competency shall be as follows:

|  |  |
| --- | --- |
| **MARKS** | **COMPETENCE RATING** |
| 80 -100 | Attained Mastery |
| 65 – 79 | Proficient |
| 50 – 64 | Competent |
| 49 and below | Not Yet Competent |
| Y | Assessment Malpractice/irregularities |

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

**Certification**

A candidate will be issued with a Certificate of Competency upon demonstration of competence in a unit of competency. To attain Kenya National TVET Certificate in industrial automation and robotics Level 4, the candidate must demonstrate competence in all the units of competency as given in qualification pack. Statement of Attainment certificate may be awarded upon demonstration of competence in certifiable element within a unit

These certificates will be issued by ……… (QAI)

MODULE ONE

## INDUSTRIAL AUTOMATION AND ROBOTIC SYSTEMS OPERATION

**UNIT CODE:** 0714 351 01A

**UNIT DURATION: 250 HOURS**

**Relationship to Occupational Standards**

**This unit addresses the unit of competency**: Operate industrial automation and robotic systems

**Unit Description**

This unit covers the competencies required in operation of an industrial automation and robotics systems. The competencies include; operating computer devices, applying digital electronic principles, controlling industrial automation and robotic systems, monitoring industrial automation and robotic systems and setting industrial automation and robotic system parameters.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hrs.)** |
| 1 | Operate computer devices | **30** |
| 2 | Apply digital electronic principles | **30** |
| 3 | Control industrial automation and robotic system | **80** |
| 4 | Monitor industrial automation and robotic system robotic system parameters | **50** |
| 5 | Set industrial automation and robotic system parameters | **60** |
|  | **TOTAL** | **250 HRS** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Operate computer devices | * 1. Meaning and importance of digital literacy      1. Procedure for turning/off a computer      2. Types of computer devices (tablets, desktop, and laptop computers).   2. Components of a computer system   3. Computer Hardware      1. The System Unit E.g. motherboard, CPU, casing,      2. Input devices e.g. pointing, keying, scanning, voice/speech recognition, direct data capture devices.      3. Output devices e.g. hardcopy output and softcopy output      4. Storage devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, hard drives, CDs & DVDs, memory cards, flash drives      5. Computer ports e.g. HDMI, DVI, VGA, USB type C, etc.   4. Start menu commands and desktop manipulation   5. Mouse use techniques   6. Keyboard parts and use techniques   7. File and files management using an operating system   8. Computer internet connection options      1. Mobile networks/data plans      2. Wireless hotspots      3. Cabled (Ethernet)   9. Mechanisms for storing files (flash drives, hard drives).   10. Computer external devices management       1. Device connections       2. Device controls (volume controls and display properties) | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |
| 1. Apply digital electronic principles | * 1. Number system concepts      1. Introduction to number systems: binary, decimal, hexadecimal      2. Conversion between number systems      3. Applications in digital electronics   2. Digital logic gate concepts      1. Introduction to logic gates: AND, OR, NOT, NAND, NOR, XOR      2. Truth tables and Boolean algebra | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |
| 1. Control industrial automation and robotic system | * 1. Applications of industrial automation and robotics control systems:      1. Programmable logic controllers      2. Human machine interface      3. Sensors      4. Actuators      5. Robotic arms      6. Robotic manipulators      7. Robotic end effectors      8. Motion control systems   2. PPEs      1. Apron      2. Safety boots      3. Goggles      4. Hand gloves      5. Helmet         1. Industrial automation and robotic system operational manual interpretation         2. Start up and shut down of industrial automation and robotic systems         3. Material flow control         4. Uses of industrial automation and robotic system safety devices      6. Guards      7. Interlocks      8. Emergency push buttons   3. Practice: control industrial automation and robotics system | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |
| 1. Monitor industrial automation and robotic system robotic system parameters | * 1. Uses of industrial automation and robotic monitoring systems.      1. Functions of industrial monitoring sensors         1. Pressure sensors         2. Position sensors         3. Infra-red sensors         4. Proximity sensors         5. Level sensors         6. Speed sensors         7. 2.1.2 Dashboards         8. Dash board types      2. Human machine interfaces      3. Display monitors         + 1. Utilisation of industrial automation and robotic system visualisation tools   2. Robotic system monitoring and control software      1. Industrial automation and robotic system technical parameters         1. Temperature         2. Pressure         3. Flow rate         4. Displacement         5. Speed         6. Vibration         7. Load and force         8. Power consumption         9. Environmental conditions   3. Practice: Monitor industrial automation and robotic system parameters | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |

|  |  |  |
| --- | --- | --- |
| 1. Set industrial automation and robotic system parameters | * 1. Industrial automation and robotics      1. System process recipe      2. Selecting recipe from the database      3. Reviewing the recipe settings      4. Applying the recipe to the system   2. Industrial automation and robotic system process parameters identification      1. Temperature      2. Pressure      3. Level      4. Material amount   3. Process parameters configuration:      1. Preparations for configuration      2. Process parameters Identification      3. Setting up parameters on the control interface      4. Calibration and tuning of the system      5. Performing safety checks      6. Monitoring and fine-tuning during operation      7. Documenting the configuration   4. Practice: Set industrial automation and robotic system parameters | * Project * Practical * Oral questioning * Third party report * Portfolio of evidence * Written tests |

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** | | | |
|  | Screwdriver Sets | Assorted screwdrivers for various applications | 2 sets | 2:25 |
|  | Wrench Sets | Assorted wrenches for mechanical work | 2 sets | 2:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with robotics training kits for experiments, approximately 50 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Guards | Safety guards for equipment operation | 1 | 1:25 |
|  | Interlocks | Safety interlocks for machinery | 1 | 1:25 |
|  | Emergency Push Buttons | Emergency stop buttons for training setups | 1 | 1:25 |
| **D** | **Equipment** | | | |
|  | Industrial Automation Kits | Complete training kits for automation and robotics | 2 | 2:25 |
|  | User Manuals | Manuals for industrial automation training | 2 | 2:25 |
|  | Hydraulic Training Kits | Kits for hydraulic systems training | 2 | 2:25 |
|  | Pneumatics Training Kits | Kits for pneumatic systems training | 2 | 2:25 |
|  | PPE Sets | Personal protective equipment for all trainees | 25 sets | 1:1 |
|  | PLC Panels | Programmable logic controller panels for training | 2 | 2:25 |
|  | HMI Panels | Human-machine interface panels for training | 2 | 2:25 |
| **E** | **Reference Materials** | | | |
|  | OSHA Documentation | Occupational Safety and Health Act resources | 1 | 1:25 |
|  | Automation Books | Books on industrial automation and robotics systems operation | 1 | 1:25 |

## PRODUCT QUALITY MAINTANANCE

**ISCED UNIT CODE:** 0714 351 03A

**UNIT DURATION: 140 HOURS**

**Relationship to Occupational Standards**

**This unit addresses the unit of competency:** Maintain product quality

**Unit Description**

This unit covers the competencies required by an industrial automation and robotics system operator to maintain quality of products produced through an industrial automated system. These competencies include; conducting product quality checks, adjusting industrial automation and robotics machinery stetting and documenting production quality activities.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
| 1 | Conduct product quality checks | **40** |
| 2 | Document production quality activities | **40** |
| 3 | Adjust industrial automation and robotics machinery settings | **60** |
|  | **TOTAL** | **140 HRS** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct product quality checks | * 1. Workplace procedures and inspection.   2. Preparation of the inspection area and equipment   3. Inspection of product according to procedures   4. Uses of product quality monitoring equipment      1. Dimensional measurement systems      2. Automated cameras      3. Vision sensors      4. Surface profilometers      5. Ultrasonic testing equipment   5. Handling defective products   6. Practice: conducting quality checks on by products | * Project * Practical * Oral questioning * Third party report * Portfolio of evidence * Written tests |
| 1. Document production quality activities | * 1. Recording of industrial automation and robotics conforming products      1. Criteria for conformance definition      2. Utilization of automation systems to capture conformance data      3. Setting up data logging for conforming products      4. Verification and validation of product conformance      5. Generation of reports for conforming product   2. Recording of industrial automation and robotics non-conforming products      1. Criteria for non-conformance definition      2. Utilization of automation systems to capture non-conformance products      3. Setting up data logging for non-conforming products      4. Non-conforming products separation and labelling      5. Documentation of non-conformance details      6. Analyzing and classifying non-conformance records      7. Generating non-conformance Reports   3. Recording of industrial automation and robotics machine setting deviations.      1. Reporting and documentation of settings deviations.      2. Preventive measures implementation   4. Practice: Product quality documentation   5. Excursion on product quality maintenance | * Project * Practical * Third party report * Portfolio of evidence * Oral questioning * Written tests |
| 1. Adjust industrial automation and robotics machinery settings | * 1. Uses of PPE      + 1. Apron        2. Safety boots        3. Goggles        4. Hand gloves        5. Helmet   2. Industrial automation and robotics machine setting deviations      + 1. Identification of the source of the deviation        2. Assessment of the impact of the deviation        3. Investigation of potential causes of the deviation   3. Uses of industrial automation and robotics machinery setting adjustment tools and equipment      1. Tools         1. Hand tools            1. Calibrators            2. Thermometers            3. Pressure gauges            4. Micrometres            5. Vernier callipers            6. Tachometers            7. Accelerometers      2. Equipment         1. Lifting gear         2. Change parts         3. Personal computers         4. PPE         5. Product quality monitoring equipment         6. Human machine interfaces Practical assessment   4. Elimination of industrial automation and robotics machine setting deviations      + 1. Cleaning and maintenance of inspection equipment        2. Deviation correction and Settings reconfiguration        3. System monitoring after correction   5. Practice: setting and adjust industrial automation and robotics machinery settings | * Project * Practical * Third party report * Portfolio of evidence * Oral questioning * Written tests |

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** | | | |
|  | Assorted Tools | General tools for various applications | Adequate |  |
|  | Calibrators | For ensuring accuracy of measurement instruments | 2 | 2:25 |
|  | Thermometers | For measuring temperature | 2 | 2:25 |
|  | Pressure Gauge | For measuring pressure in systems | 1 | 1:25 |
|  | Micrometers | For precise measurement of small dimensions | 5 | 1:5 |
|  | Vernier Calipers | For measuring internal and external dimensions | 5 | 1:5 |
|  | Tachometers | For measuring rotational speed | 2 | 2:25 |
|  | Accelerometers | For measuring acceleration | 1 | 2:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with robotics training kits for experiments, approximately 50 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Dimensional measurement systems | Systems for measuring dimensions accurately | 1 | 1:25 |
|  | Automated cameras | For visual inspection and monitoring | 1 | 1:25 |
|  | Vision sensors | For detecting and measuring visual parameters | 1 | 1:25 |
| **D** | **Equipment** | | | |
|  | Industrial automation kits | Complete training kits for automation and robotics | 2 | 2:25 |
|  | User manuals | Manuals for available industrial automation training | 2 | 2:25 |
|  | Service manuals | Manuals for servicing training equipment | 1 | 1:25 |
|  | PPE sets | Personal protective equipment for all trainees | 25 sets | 1:1 |
|  | PLC panels | Programmable logic controller panels for training | 2 | 2:25 |
|  | HMI panels | Human-machine interface panels for training | 2 | 2:25 |
|  | Product quality monitoring equipment | For monitoring quality in production processes | 1 | 1:25 |
|  | Surface profilometers | For measuring surface roughness and texture | 1 | 1:25 |
|  | Ultrasonic testing equipment | For non-destructive testing of materials | 1 | 1:25 |
| **E** | **Reference Materials** | | | |
|  | OSHA documentation | Occupational Safety and Health Act resources | 1 | 1:25 |
|  | Online course materials | Access links, user guides, and handouts from platforms | 1 set | 1:25 |
|  | Printed reference booklets | Summarizing quality control and assurance essentials | 1 set | 1:25 |
|  | Workbooks | Exercises on inspection, defect analysis, and corrective actions | 1 set | 1:25 |

MODULE TWO

## INDUSTRIAL AUTOMATION AND ROBOTIC SYSTEMS MAINTENANCE

**UNIT CODE:** 0714 351 02A

**UNIT DURATION: 220 HOURS**

**Relationship to Occupational Standards**

**This unit addresses the unit of competency**: Operate industrial automation and robotic systems

**Unit Description**

This unit covers the competencies required by an operator to carry out maintenance of industrial automation and robotic systems. These competencies include; applying workshop safety, performing housekeeping, carrying out industrial automation and robotic system autonomous maintenance, carrying out industrial automation and robotic system troubleshooting and replacing industrial automation and robotic system parts

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
| 1 | Apply workshop safety | 40 |
| 2 | Perform housekeeping | 30 |
| 3 | Carry out industrial automation and robotic system autonomous maintenance |  |
| 4 | Carry out industrial automation and robotic system troubleshooting | 70 |
| 5 | Replace industrial automation and robotic system parts | 80 |
|  | **TOTAL** | **220HRS** |

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

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - 1. Apply workshop safety | * 1. Workshop safety      1. Definition      2. Types and uses of PPE’s   2. Emergence responses steps      1. Common emergencies         1. Fire         2. Chemical spills         3. Injury response   3. Fire safety      1. Fire extinguishers types and uses      2. Flammable materials identification      3. Fire prevention   4. Safe handling and disposal of chemicals and materials      1. Chemical hazard identification      2. Safe handling procedure      3. Storage and labelling of chemicals      4. Chemical disposal procedures      5. Emergency response for chemical exposure   5. Identifying and marking hazardous zones      1. Common hazardous zones         1. Flammable zones         2. High traffic zones         3. Electrical hazard zones         4. Chemical storage areas   6. Work area organization and maintenance      1. Setting up      2. Proper storage and labelling of tools and equipment   7. Workplace hazards      1. Physical hazards         1. Noises         2. Vibration         3. Heat         4. Sharp object      2. Chemical hazards         1. Fuels         2. Oils         3. Cleaning agents      3. Electric hazards         1. Live wires         2. Batteries         3. Electrical systems   8. Workshop accidents, causes and responses      1. Slip, strips and falls      2. Cuts and abrasion      3. Burns      4. Electrical shocks | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| * + - 1. Perform housekeeping | * 1. Housekeeping.      1. Definition      2. Importance of housekeeping   2. Housekeeping activities and their importance      1. Tool and equipment organization      2. Work area cleanliness      3. Safe handling and disposal of hazardous materials      4. Inspection and maintenance of equipment      5. Personal protective equipment management      6. Air and ventilation maintenance      7. Incident prevention and reporting   3. Housekeeping tools and equipment      1. Uses and maintenance      2. Brooms and brushes         1. Dustpans and squeegees         2. Vacuum cleaners         3. Mops and mop buckets         4. Waste bins and recycling containers   4. Housekeeping materials      1. Cleaning cloths and rags      2. Cleaning agents and solvents      3. Lubricants      4. Gloves and PPE’s      5. Disposable bags and liners   5. Workshop waste sorting and disposal      1. Types of waste         1. General waste         2. Hazardous waste         3. Recyclable waste         4. Organic waste         5. E-waste      2. Waste sorting procedure         1. Designated bins for different types of waste         2. Sorting by material         3. Pre-sorting hazardous waste      3. Hazardous waste disposal         1. Chemical waste         2. Used oil and solvents         3. Paints and finishes | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| * + - 1. Carry out industrial automation and robotic system autonomous maintenance | * 1. Industrial automation and robotic system autonomous maintenance tasks:   Routine inspection   * + 1. Cleaning     2. Degreasing     3. Lubrication     4. Tightening     5. Aligning   1. Uses of industrial automation and robotic system autonomous maintenance tools and equipment   2. Tools      1. Flashlights      2. Hand tools      3. Thermal imaging cameras      4. Grease guns      5. Oil guns      6. Oil dispensers      7. Tachometers      8. Vibration meters      9. Multimeters   3. Equipment      1. Air compressors      2. Solvent sprayers      3. Safety equipment   4. Uses of PPE      1. Apron      2. Safety boots      3. Goggles      4. Hand gloves      5. Helmet   5. Interpretation of industrial automation and robotic system service manual   6. Industrial automation and robotic system autonomous maintenance tasks:      1. Routine inspection      2. Cleaning      3. Degreasing      4. Lubrication      5. Tightening      6. Aligning   7. Industrial automation and robotic system autonomous maintenance checklists preparation   8. Industrial automation and robotic system autonomous maintenance checklists filling   9. Practice: maintain industrial automation and robotic system. | * Carry out industrial automation and robotic system autonomous maintenance |
| * + - 1. Carry out industrial automation and robotic system troubleshooting | * 1. Identification of industrial automation and robotic system alerts:      1. Warnings      2. Alarms   2. Industrial automation and robotic system alerts clearance      1. Identifying the type and source of the alert      2. Understanding the alert description and code      3. Performing initial troubleshooting      4. Clearing mechanical or electrical issues      5. Verifying software and control system configurations      6. Performing safety checks      7. Clearing the alert on the control Interface      8. Documenting the alert and corrective actions      9. Testing the system before full operation   3. Practice: troubleshoot industrial automation and robotics system | * Carry out industrial automation and robotic system troubleshooting |
| * + - 1. Replace industrial automation and robotic system parts | * 1. Consumable industrial automation and robotic system parts identification and usage      1. Bearings         1. Types of bearing         2. Causes of bearing wear         3. Symptoms of worn-out bearing      2. Seals and gaskets         1. Types of sealants and gaskets         2. Cause of worn-out seals and gaskets         3. Symptoms of worn-out seals and gaskets of      3. Filters         1. Types of filters         2. Maintenance of filters      4. Belts and chains         1. Types of belts and chains         2. Causes of worn-out belts and chains         3. Symptoms of worn-out belts and chains      5. Wear plates and liners         1. Types of plates and liners         2. Causes of worn-out plates and liners         3. Symptoms of worn-out plates and liners      6. Cutting tools         1. Types of cutting tools         2. Maintenance of cutting tools      7. Batteries and power sources         1. Types of batteries and power sources         2. Maintenance of batteries and power sources   2. Purpose of tools and equipment used in replacement of industrial automation and robotics system parts      1. Tools         1. Flashlights         2. Hand tools         3. Thermal imaging cameras         4. Grease guns         5. Oil guns         6. Oil dispensers         7. Tachometers         8. Vibration meters         9. Multimeters      2. Equipment         1. Air compressors         2. Solvent sprayers         3. Safety equipment   3. Industrial automation and robotic system consumable parts service      1. Replenish lubricants      2. Cleaning equipment      3. Replace worn out parts      4. Replenishing cooling fluids      5. Service record documentation      6. Housekeeping activities after service   4. Practice: repair and maintenance of industrial automation and robotics system. | * Replace industrial automation and robotic system parts |

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** | | | |
|  | Screwdriver Sets | Assorted screwdrivers for various applications | 2 sets | 2:25 |
|  | Wrench Sets | Assorted wrenches for mechanical work | 2 sets | 2:25 |
|  | Digital Flashlights | Portable flashlights for visibility during hands-on work | 2 | 2:25 |
|  | Grease Guns | For applying grease to machinery | 2 | 2:23 |
|  | Digital Multimeters | For voltage, current, and resistance measurements | 2 | 2:25 |
|  | Oil Guns | For applying oil to machinery | 2 | 2:25 |
|  | Oil Dispensers | For dispensing oil accurately | 2 | 2:25 |
|  | Tachometers | For measuring rotational speed | 2 | 2:25 |
|  | Vibration Meter | For measuring vibration levels in equipment | 1 | 1:25 |
|  | Cutting Tools | For cutting materials in practical applications | 2 | 2:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with robotics training kits for experiments, approximately 50 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Sensors | For detecting various parameters in automation systems | 5 | 1:5 |
|  | Actuators | For controlling movement in mechanical systems | 5 | 1:5 |
|  | Bearings | For reducing friction in rotating components | 5 | 1:5 |
|  | Seals and Gaskets | For preventing leaks and maintaining pressure | 5 | 1:5 |
|  | Filters | For purifying fluids in systems | 3 | 1:8.3 |
|  | Belts and Chains | For power transmission in machinery | 2 | 1:12.5 |
|  | Wear Plates and Liners | For reducing wear in machinery components | 2 | 1:12.5 |
|  | Batteries and Power Sources | For powering equipment and sensors | 2 | 1:12.5 |
| **D** | **Equipment** | | | |
|  | Industrial Automation Kits | Complete training kits for automation and robotics | 2 | 1:12.5 |
|  | Hydraulic Training Kits | Kits for hydraulic systems training | 2 | 1:12.5 |
|  | Pneumatics Training Kits | Kits for pneumatic systems training | 2 | 1:12.5 |
|  | User Manuals | Manuals for each available training kit | 1 | 1:25 |
|  | Service Manuals | Manuals for servicing training equipment | 1 | 1:25 |
|  | PPE Sets | Personal protective equipment for all trainees | 25 sets | 1:1 |
|  | PLC Panels | Programmable logic controller panels for training | 2 | 1:12.5 |
|  | HMI Panels | Human-machine interface panels for training | 2 | 1:12.5 |
| **E** | **Reference Materials** | | | |
|  | OSHA Documentation | Occupational Safety and Health Act resources | 1 | 1:25 |
|  | Maintenance Books | Books on industrial automation and robotics systems maintenance | 1 | 1:25 |