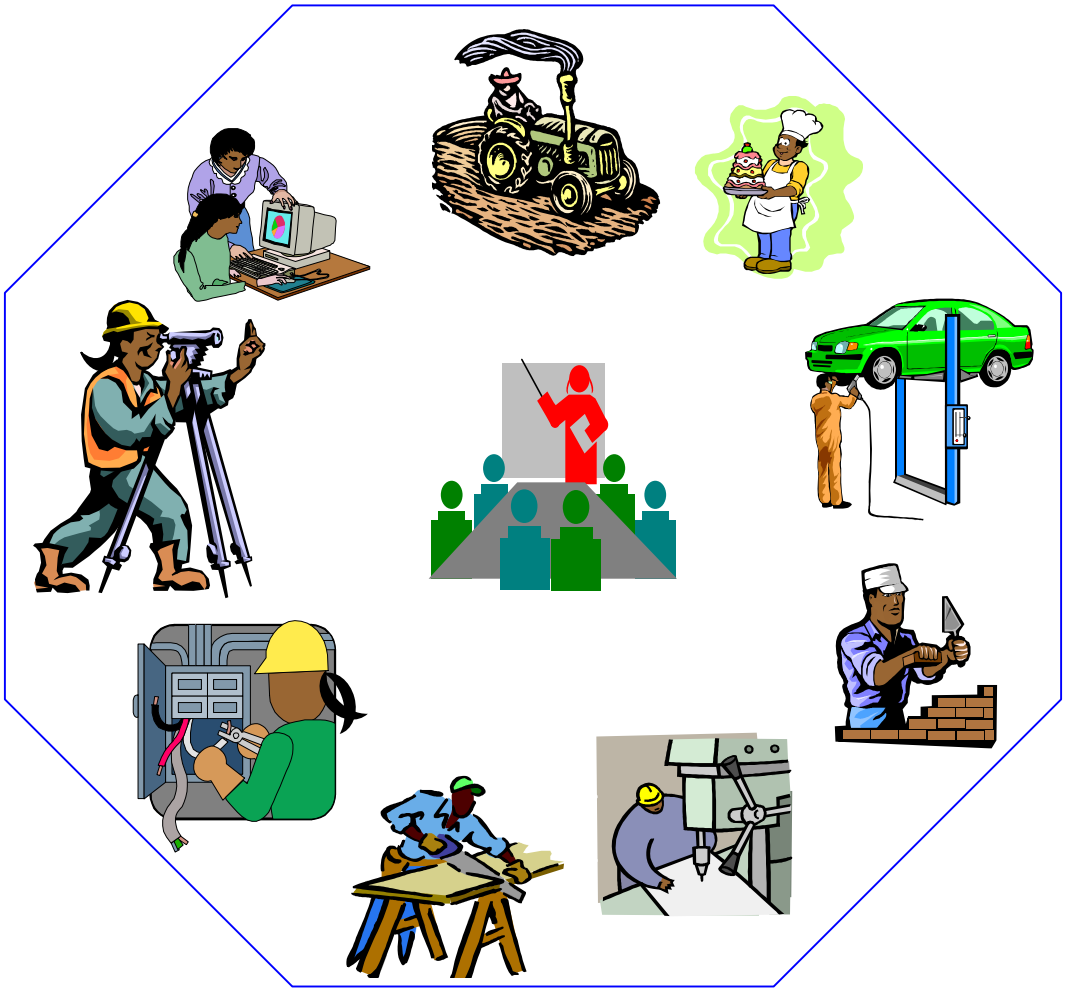
Federal Democratic Republic of Ethiopia

OCCUPATIONAL STANDARD

MECHATRONICS AND INSTRUMENT SERVICING MANAGEMENT

NTQF Level IV



Ministry of Education

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Introduction

Ethiopia has embarked on a process of reforming its TVET-System. Within the policies and strategies of the Ethiopian Government, technology transformation – by using international standards and international best practices as the basis, and, adopting, adapting and verifying them in the Ethiopian context – is a pivotal element. TVET is given an important role with regard to technology transfer. The new paradigm in the outcome-based TVET system is the orientation at the current and anticipated future demand of the economy and the labor market.

The Ethiopia Occupational Standards (EOS) is the core element of the Ethiopian National TVET-Strategy and an important factor within the context of the National TVET Qualification Framework (NTQF).They are national Ethiopia standards, which define the occupational requirements and expected outcome related to a specific occupation without taking TVET delivery into account.

This document details the mandatory format, sequencing, wording and layout for the Ethiopia Occupational Standard which comprised of Units of Competence.

A Unit of Competence describes a distinct work activity. It is documented in a standard format that comprises:

- Occupational title, NTQF level
- Unit code
- Unit title
- Unit descriptor
- Elements and Performance criteria
- Variables and Range statement
- Evidence guide

Together all the parts of a Unit of Competence guide the assessor in determining whether the candidate is competent.

The ensuing sections of this EOS document comprise a description of the occupation with all the key components of a Unit of Competence:

- chart with an overview of all Units of Competence for the respective level including the Unit Codes and the Unit Titles
- contents of each Unit of Competence (competence standard)
- occupational map providing the technical and vocational education and training (TVET) providers with information and important requirements to consider when designing training programs for this standards and for the individual, a career path

UNIT OF COMPETENCE CHART

Occupational Standard: Mechatronics and Instrument Servicing Management

Occupational Code: EEL MIS4

NTQF Level IV

EEL MIS4 01 0511 Plan and Organize Work	EEL MIS4 02 0511 Manage Installation and Maintenance Operation	EEL MIS4 03 0511 Perform Technical Consultation
EEL MIS4 04 0511 Install Mechatronics Device	EEL MIS4 05 0511 Configure and Adjust Mechatronics Device	EEL MIS4 06 0511 Maintain and Repair Mechatronics Devices and Process Instrument
EEL MIS4 07 0511 Diagnose and Troubleshoot Mechatronics System	EEL MIS4 08 0511 Apply Problem Solving Techniques	EEL MIS4 09 0511 Conduct Loop Check
EEL MIS4 10 0511 Install process Instrumentation and Control Cabling and Tubing	EEL MIS4 11 0511 Calibrate and Test Measuring Instruments	EEL MIS4 12 0511 Find and Repair Faults in Measuring and Analysis Systems
EEL MIS4 13 0511 Find and Repair Faults in Electrical Apparatus and Circuits	EEL MIS4 14 0511 Commission Mechatronics System	EEL MIS4 15 0511 Develop Individual and Teams
EEL MIS4 16 0511 Utilize Specialized Communication Skills	EEL MIS4 17 0511 Establish Quality Systems and Procedures	EEL MIS4 18 0511 Manage and Maintain Small/Medium Business Operations
EEL MIS4 19 0511 Migrate to New Technology	EEL MIS4 20 1012 Manage Continuous Improvement System	

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Plan and Organize Work Activities**
Unit Code	**EEL MIS4 01 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitude required in planning and organizing work. It may be applied to a small independent operation or to a section of a large organization.

Element	Performance Criteria
1. Set objectives	1.1 ***Objectives*** are consistent with and linked to work activities in accordance with organizational aims 1.2 Objectives are stated as measurable targets with clear time frames 1.3 Support and commitment of team members are reflected in the objectives 1.4 Realistic and attainable objectives are identified
2. Plan and schedule work activities	2.1 Tasks/work activities to be completed are identified and prioritized as directed 2.2 Tasks/work activities are broken down into steps in accordance with set time frames achievable components in accordance with set time frames 2.3 ***Resources*** are allocated as per requirements of the activity 2.4 ***Schedule of work activities*** is coordinated with personnel concerned
3. Implement work plans	3.1 ***Work methods and practices*** are identified in consultation with personnel concerned 3.2 ***Work plans*** are implemented in accordance with set time frames, resources and ***standards***
4. Monitor work activities	4.1 Work activities are monitored and compared with set objectives 4.2 Work performance is monitored 4.3 Deviations from work activities are reported and recommendations are coordinated with appropriate personnel and in accordance with set standards 4.4 Reporting requirements are complied with in accordance with recommended format 4.5 Observe timeliness of report 4.6 Files are established and maintained in accordance with standard operating procedures

5. Review and evaluate work plans and activities	5.1 Work plans, strategies and implementation are reviewed based on accurate, relevant and current information 5.2 Review is based on comprehensive consultation with appropriate personnel on outcomes of work plans and reliable feedback 5.3 Results of review are provided to concerned parties and formed as the basis for adjustments/simplifications to be made to policies, processes and activities 5.4 Performance appraisal is conducted in accordance with organization rules and regulations 5.5 Performance appraisal report is prepared and documented regularly as per organization requirements. 5.6 Recommendations are prepared and presented to ***appropriate personnel/authorities*** 5.7 ***Feedback mechanisms*** are implemented in line with organization policies

Variable	**Range**
Objectives	• Specific • General
Resources	Include but not limited to: • Personnel • Equipment and technology • Services • Supplies and materials • Sources for accessing specialist advice • Budget
Schedule of work activities	Include but not limited to: • Daily/weekly/monthly/quarterly/yearly • Work-based • Contractual • Regular • Confidential • Disclosure • Non-disclosure
Work methods and practices	Include but not limited to: • Legislated regulations and codes of practice • Industry regulations and codes of practice • Occupational health and safety practices
Work plans	Include but not limited to: • Daily/weekly/monthly/quarterly/yearly work plans • Project plans • Program plans • Organization strategic and restructuring plans • Resource plans • Skills development plans • Management strategies and objectives
Standards	Include but not limited to: • Performance targets

	• Performance management and appraisal systems • National competency standards • Employment contracts • Client contracts • Discipline procedures • Workplace assessment guidelines • Internal quality assurance • Internal and external accountability and auditing requirements • Training Regulation Standards • Safety Standards
Appropriate personnel/ authorities	Include but not limited to: • Appropriate personnel include: • Management • Line Staff
Feedback mechanisms	Include but not limited to: • Verbal feedback • Informal feedback • Formal feedback • Questionnaire • Survey • Group discussion

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • set objectives • planned and scheduled work activities • implemented work plans • monitored work activities • reviewed and evaluated work plans and activities
Underpinning Knowledge	Include but not limited to: • Organization's strategic plan, policies rules and regulations, laws and objectives for work unit activities and priorities • Organizations policies, strategic plans, guidelines related to the role of the work unit • Team work and consultation strategies
Underpinning Skills	Include but not limited to: • Leading • Planning, Organizing and Coordinating • Communication Skills • Inter-and intra-person/motivation skills • Presentation skills
Resource Implications	Include but not limited to: • Workplace or fully equipped location with necessary tools and equipment as well as consumable materials
Assessment Methods	Competence may be assessed through:

	• Interview / Written exam • Observation / Demonstration
Context for Assessment	Competence may be assessed in the workplace or in simulated work

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Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Manage Installation and Maintenance Operation**
Unit Code	**EEL MIS4 01 0511**
Unit Descriptor	This unit covers the knowledge, attitudes and skills required to develop and monitor the implementation of and operational plan and to provide efficient and effective workplace practices within the organization's productivity and profitability plans.

Elements	Performance Criteria
1. Develop operational plan	1.1 Resource requirements are researched, analyzed and documented and an operational plan is developed and/or implemented in consultation with **relevant personnel, colleagues and specialist resource managers** 1.2 **Consultation processes** are developed and/or implemented as an integral part of the operational planning process 1.3 **Operational plans** are developed to contribute to the achievement of the organization's performance/business plan 1.4 Details of the operational plan include the development of **key performance** indicators to measure organizational performance 1.5 **Contingency plans** are developed and implemented at appropriate stages of operational planning 1.6 The development and presentation of proposals for resource requirements are assisted by a variety of information sources, and specialist advice is sought as required
2. Plan and schedule work activities	2.1 Tasks/work activities to be completed are identified and prioritized as directed 2.2 Tasks/work activities are broken down into achievable components in accordance with set time frames 2.3 ***Resources*** are allocated as per requirements of the activity 2.4 ***Schedule of work activities*** is coordinated with personnel concerned
3. Plan and manage resource acquisition	3.1 Strategies are developed and implemented to ensure that employees are recruited and/or inducted within the organization's human resource management policies and practices 3.2 Strategies are developed and implemented to ensure that

	physical resources and services are acquired in accordance with the ***organization's policies, practices and procedures***
4. Monitor and review operations	4.1 Performance systems and processes are developed, monitored and reviewed to assess progress in achieving profit and productivity plans and targets 4.2 Budget and actual financial information is analyzed and interpreted to monitor and review profit and productivity performance 4.3 Areas of underperformance are identified, solutions recommended, and prompt action is taken to rectify the situation 4.4 Implementation of developed systems are monitored to ensure that mentoring and coaching are provided to support individuals and teams to use resources effectively, economically and safely 4.5 Recommendations for variations to operational plans are negotiated and approved by designated persons/groups 4.6 Systems are developed and implemented to ensure that procedures and records associated with documenting performance are managed in accordance with the organization's requirements
5. Review and evaluate work performance	5.1 Work plans, strategies and implementation are reviewed based on accurate, relevant and current information 5.2 Review is based on comprehensive consultation with appropriate personnel on outcomes of work plans and reliable feedback 5.3 Results of review are provided to concerned parties and formed as the basis for adjustments/simplifications to be made to policies, processes and activities 5.4 Performance appraisal is conducted in accordance with organization rules and regulations 5.5 Performance appraisal report is prepared and documented regularly as per organization requirements. 5.6 Recommendations are prepared and presented to appropriate personnel/authorities 5.7 Feedback mechanisms are implemented in line with organization policies

Variable	Range
Relevant personnel, colleagues and specialist resource managers	Include but not limited to: • managers • supervisors • other employees • OH& S committee(s) and other people with specialist responsibilities • union or employee representatives • people at the same level or more senior managers • people from a wide range of social, cultural and ethnic Backgrounds
Consultation processes	Include but not limited to: • meetings, interviews, brainstorming sessions, email/internet communications, newsletters or other processes and devices which ensure that all employees have the opportunity to contribute to team and individual operational plans • mechanisms used to provide feedback to the work team in relation to outcomes of consultation
Operational plans	Include but not limited to: • tactical plans developed by the department or section to detail product and service performance • organizational plans
Key performance indicators	Include but not limited to: • measures for monitoring or evaluating the efficiency or effectiveness of a system which may be used to demonstrate accountability and to identify areas for improvements
Contingency plans	Include but not limited to: • rental, hire purchase or alternative means of procurement of required materials, equipment and stock • contracting out or outsourcing human resource and other functions or tasks • strategies for reducing costs, wastage, stock or consumables • diversification of outcomes • recycling and re-use • finding cheaper or lower quality raw materials and consumables • seeking further funding • increasing sales or production • risk identification, assessment and management processes • succession planning
Organization's policies, practices and procedures	Include but not limited to: • those organizational guidelines which govern and prescribe operational functions, such as the acquisition and management of human and physical resources • standard operating procedures • undocumented practices in line with organizational operations

	• organizational culture
Designated persons/groups	Include but not limited to: • managers or supervisors whose roles and responsibilities include decision making on operations • other work groups or teams whose work will be affected by recommendations for variations • groups designated in workplace policies and procedures • other stakeholders such as Board members
Feedback mechanisms	Feedback mechanisms include: • verbal feedback • informal feedback • formal feedback • questionnaire • survey • group discussion

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • developing operational plan • planning and managing resource acquisition • monitoring and reviewing operational performance
Underpinning Knowledge and Attitudes	Include but not limited to: Demonstrates knowledge of: • relevant legislation from all levels of government that affects business operation, especially in regard to occupational health and safety and environmental issues, equal opportunity, industrial relations and anti-discrimination • the principles and techniques involved in the management and organization of: o planning and managing operations o consultation and communication o contingency planning o resource planning and acquisition o resource management systems o budgeting and financial analysis and interpretation o monitoring and review of performance systems and processes o reporting performance o problem identification and resolution o alternative approaches to improving resource usage and eliminating resource inefficiencies and waste o ways of supporting individuals/teams who have difficulty in performing to the required standard
Underpinning Skills	Include but not limited to: Demonstrates skills to: • relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities • functional literacy skills to access and use workplace information

	• monitor and review a safe workplace and environment • access and use feedback to improve operational performance • prepare recommendations to improve operational plans • access and use established systems and processes • coach and mentor skills to provide support to colleagues
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OH& S practices.
Methods of Assessment	Competency may be assessed through: • Interview/Written Test • Observation/Demonstration (Simulation)
Context of Assessment	Competency may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Perform Technical Consultation**
Unit Code	**ELE MIS4 03 0511**
Unit Descriptor	This unit covers the knowledge, attitudes and skills required to conduct technical consultation, provide recommendation and solution for technical problems and operation procedures, improve the performance of operation and maintenance services and proposed guidelines and systematic approach on maintenance practices within the organization and to enhance the productivity and smooth operation of the industry.

EELments	Performance Criteria
1. Conduct inspection	1.1 Industry are inspected and technical problems are addressed, analyzed the problems and prepare document for evaluation and consultation with ***Technical personnel, specialist and technical manager*** 1.2 ***Consultation processes*** are developed and/or implemented as an integral part of the operational planning process 1.3 ***Evaluation and work plans*** are develop to create a systematic solution for the technical problems
2. Evaluate technical problems	2.1 Technical problems are identified, evaluated and create systematic solution/remedy and prioritized as directed 2.2 ***Required resources*** are allocated as per requirements of the activity
3 Prepare technical recommendation	3.1 ***Established OH& S*** and risk control measures and procedures in preparation for the work are followed. 3.2 ***Policies and procedures*** are developed to include OH& S practices, skills required and frequency and level of maintenance work. 3.3 Project proposal are reviewed and ensure that all necessary documents, manuals and checklist are obtained 3.4 ***Schedule of work activities*** are prepared according to manufacturers recommendation 3.5 Appropriately competent persons are engaged to assess the risks associated with individual equipment failure. 3.6 Level and frequency of repair/replace to be done under maintenance work is established from risk assessment reports and manufacture's recommendations and standards reflecting acceptable exposure to risk of equipment failure. 3.7 Systems are established to manage and record technical work

	activities in accordance with organization and regulatory requirements

Variable	Range
Technical personnel, specialist and technical manager	Include but not limited to: • managers • supervisors • other employees • OH& S committee(s) and other people with specialist • responsibilities • union or employee representatives • people at the same level or more senior managers • people from a wide range of social, cultural and ethnic Backgrounds
Consultation processes	Include but not limited to: • meetings, interviews, brainstorming sessions, email/internet communications, newsletters or other processes and devices which ensure that all employees have the opportunity to contribute to team and individual operational plans • mechanisms used to provide feedback to the work team in relation to outcomes of consultation
Evaluation and work plans	• measures for monitoring or evaluating the efficiency or effectiveness of a which may be used to demonstrate accountability and to identify areas for improvements
Required resources	• Work description are establish and prepared • Tools and material • Designated persons/group based on their own specialization • Manuals and manufacturers guide
Established OH& S	include but not limited to: • hazard and risk assessment mechanisms • implementation of safety regulations • safety training • safety systems incorporating, • work clearance procedures • isolation procedures • gas and vapor • monitoring/testing procedures • use of protective equipment and clothing • use of codes of practice
Policies and procedures	Include but not limited to: • Pro-active maintenance procedures • Re-active maintenance procedure • Operation and servicing procedures • Health and safety procedures

Schedule of work activities	Include but not limited to: • Tasks/work activities to be completed are identified and prioritized as directed • Tasks/work activities are set into achievable components in accordance with time frames • Resources are allocated as per requirements of the activity • Schedule of work activities is coordinated with personnel concerned

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • Analyzing electrical and mechanical faults • Operation and servicing procedures • Provide technical recommendation
Underpinning Knowledge and Attitudes	Include but not limited to: Demonstrates knowledge of: • Electromechanical device and equipment installation • maintaining and servicing Industrial Electrical Machines and Drives • Fundamentals of troubleshooting and repair of electrical machines and drives • Code of practice in industrial electrical machines installation • Basic consultancy training • Codes of practice and guidelines for the organization • Organizations policy and procedures for negotiations • Decision making and conflict resolution strategies procedures • Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation • Flexibility • Empathy
Underpinning Skills	Include but not limited: Demonstrates skills to: • Trouble shoot and repair electro mechanical equipment • Interpersonal skills to develop rapport with other parties • Communication skills (verbal and listening) • Observation skills • Negotiation skills
Resources Implication	Include but not limited to: Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.

Methods of Assessment	Competency may be assessed through: • Interview/Written Test • Observation/Demonstration (Simulation)
Context of Assessment	Competency may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Install Mechatronics Devices**
Unit Code	**EEL MIS4 04 0511**
Unit Descriptor	This unit covers the necessary knowledge, skills and attitude required in preparing, identifying, installing and testing mechatronic devices.

Elements	Performance Criteria
1. Prepare and Plan to install mechatronic device	1.1 Installation is planed and prepared in line with job requirements 1.2 Work instructions are read and interpreted to determine job requirements. 1.3 ***Tools, equipment*** *and* ***testing devices*** needed to carry out the installation work are selected in accordance with established procedures and checked for correct operation and safety. 1.4 ***Materials*** necessary to complete the work are obtained in accordance with job requirements.
2. Install Mechatronics devices	2.1 Read and interpret work instruction according to the installation job requirements 2.2 Identify tools, equipment testing devices and materials needed for installation 2.3 Identify the PPE and OHS policies and procedures equired for the installation job 2.4 Install mechatronics devices 2.5 Conduct test on the installed mechatronics devices
3. Configure and adjust mechatronics devices	3.1 Instruction according to the configuration and adjustment job requirements 3.2 Identify tools, equipment testing devices and materials needed for configuration and adjustment 3.3 Identify the PPE and OHS policies and procedures required for the configuration and adjustment job 3.4 Configure and adjust mechatronics devices according to standard operating procedures 3.5 Conduct test on the configured and adjusted mechatronics devices

Variable	Range

Tools	Include but not limited to: • Long-nosed pliers • Diagonal cutters • Standard screwdrivers • Phillips screwdrivers • Electrical pliers • Soldering iron • Adjustable wrench • Wire stripper • Crimping tool • Allen key wrench • Jeweller's screwdrivers • Combination wrench, metric • Combination wrench, English
Equipment/testing devices	includes but not limited to: • Transmitters or transducers • Air compressor • Regulated power supplies • Cylinder actuator • Stepper motor • Servomotor • Variable frequency drive • Buzzers • Industrial panel switches • Indicating lamps • Directional solenoid valves • Filter-regulator-lubricator set • Pressure gage • Limit switches • Photoelectric switches • Proximity switches • Relays • Magnetic contactors • Timers • Counters • Desktop/Laptop PC • Safety helmet • Safety harness • Safety glasses/goggles • Ear plugs/ear muffs • Gas mask • Face shield
Materials	Include but not limited to: • activity sheets

	• Schematic diagrams • Component layout • Technical brochures • Technical references • Solder lead • Shielded cable • Terminal lugs • Terminal strips/blocks • Cotton gloves • Plastic tubing • Quick-connect fittings • Electrical tape • Wire markers • Cable ties
Personal protective equipment	Include but not limited to: • Ear muffs/plugs • Goggles/glasses/ face shield • Safety hat • Safety apparel/suit • Safety belt/harness • Safety shoes • Mask • Gloves
OH & S policies and procedures	• OH & S guidelines • Ethiopia environmental standards

Evidence Guide	
Critical Aspects of Competence	Assessment require evidence that the candidate: • interpreted work instructions according to job requirements • Plan and prepare to install mechatronics devices as per OH & S requirements • installed Mechatronics devices in accordance with technical requirements • conducted inspection and tests accurately on the devices using standard procedures • documented the tasks undertaken
Underpinning Knowledge	Include but not limited to: • occupational health and safety • Mechatronics standards • Pneumatics & electro-pneumatics • Hydraulics • Industrial motors • Components specification of pneumatic and hydraulic • Problem solving in emergency situation • Electromechanical technology • Drawing Interpretation • Use of test equipment/instrument • principles of instrumentation

	• process variable measurements (pressure, level, flow, temperature, analysis, etc.) • process control theory • process control system (single-loop & multi-loop controllers, DCS, DAS, SCADA, etc) • sensors, transmitters, transducers & converters • programmable logic controllers • control valves and final control elements
Underpinning Skills	• Interpret work instructions • Interpret and define work procedures • Selection and use of proper tools & equipment • Installation skills • Problem solving in unplanned events
Resource Implication	Include but not limited to: • Mechatronics devices • Tools and test equipment and calibrators • Materials and PPE • Technical manuals and Instrumentation & Control drawings
Method of Assessment	• Observation / Demonstration • Oral Questioning / written test
Context of Assessment	Assessment may be conducted in the workplace or in a simulated work environment

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Configure and Adjust Mechatronics Device**
Unit Code	**ELE MIS4 05 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes needed to configure and adjust mechatronics device

Elements	Performance Criteria
1. Plan and prepare for configuration & adjustment	1.1 ***OH& S policies and procedures*** are observed in line with job requirements. 1.2 Configuration and calibration are planned and prepared in line with job requirements. 1.3 Instrumentation and control devices configured and calibrated are identified based on the Job/Service Order or instructions 1.4 ***Mechatronics standards*** are conditioned according to plan or standards in line with the job requirements 1.5 ***Mechatronics devices/system*** for configuration and calibration are checked against specifications and requirements. 1.6 ***Materials,*** necessary to complete the work are obtained in accordance with established procedures and checked against job requirements. 1.7 ***Tools, equipment and testing devices*** needed for configuration and calibration of the instrumentation and control devices are obtained and checked for correct operation and safety
2. Configure mechatronics devices	2.1 Appropriate ***personal protective equipment*** is used and OHS policies and procedures are followed 2.2 Normal functioning systems and components are checked in accordance with manufacturer's instructions 2.3 **Fault/s or problem/s** in the device is/are diagnosed in line with the standard operating procedures. 2.4 Mechatronics devices are configured in line with the standard operating procedures. 2.5 Unplanned events or conditions are responded to in accordance with established procedures
3. Calibrate Mechatronics devices	3.1 Appropriate personal protective equipment is used based on OH& S policies and procedures. 3.2 Normal functions of devices are checked in accordance with manufacturer's instructions & standard procedures. 3.3 Mechatronics devices to be calibrated are conditioned according to plan or standards 3.4 Fault/s or problem/s in the device is/are diagnosed in line with the standard operating procedures.

	3.5 Mechatronics devices are calibrated and / or adjusted in line with the standard operating procedures. 3.6 Unplanned events or conditions are responded to in accordance with established procedures
4. Inspect and test configured and calibrated Mechatronics devices	4.1 Configured and calibrated devices are initially inspected for accurateness before final functional tests are conducted 4.2 Final inspections are undertaken to ensure that the configuration and calibration done on the devices conforms with the manufacturer's instruction/ manual 4.3 Mecharonics devices are checked to ensure safe operation 4.4 Report is prepared/ completed according to company requirements.

Variable	**Range**
OH & S policies and procedures	• OH& S guidelines • Ethiopian environmental proclamations and regulations
Mechatronic standards	Include but not limited to: • OIML (International Organization for Legal Metrology) Standards) or Ethiopian Standards (ES) • ISA (Instrumentation, Systems and Automation) Society (formerly Instrument Society of America) • ANSI (American National Standards Institute) • ASME (American Society of Mechanical Engineers) • NEC (National Electric Code) • IEC (International Electro technical Commission)
Mechatronics devices/systems	Include but not limited to: • Sensoric elements • Electro-mechanical element • Pneumatic and electro-pneumatic elements • Hydraulic elements • Electronic logic control elements • Robotic control elements • Actuator & output devices
Materials	Include but not limited to: • Solder lead • Shielded cable • Terminal lugs • Terminal strips/blocks • Cotton gloves • Plastic tubing • Quick-connect fittings • Wires
Tools	Include but not limited to:

	• Pliers • Diagonal cutters • Standard screw driver • Philips screw drivers • Electrical pliers • soldering iron/gun • wrenches, hexagonal wrenches or Allen keys • Allen wrenches
Equipment/testing devices	Include but not limited to: • Computer • Handheld configurator • Transmitter or transducer • Cylinder actuator • Stepper motor • Power supply equipment • Multi-meter • Calibrator/, configurator or programmer, instrument transducer • Signal generator • Oscilloscope • Standard gauges
Personal protective equipment	Include but not limited to: • Ear muffs/plugs • Goggles/glasses/face shield • Safety belt/ harness • Safety shoes • Safety apparel/suit, hat, mask and gloves
Fault/s or problem/s	• mechanical • electrical • electronics • computer-based • pneumatic • hydraulics

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • interpreted work instructions according to job requirements • diagnosed faults or problems on the device • configured the identified devices • conditioned appropriately instrument or device to be calibrated • calibrated and/ or adjusted identified devices diagnosed faults or problems on the devices • checked calibrated devices to ensure safety • checked configured devices to ensure safety • documented the tasks undertaken
Underpinning Knowledge	Include but not limited to: • Occupational health and safety • Mechatronics standards • Use of tools and test equipment and calibrators

	• Mathematical calculations • Electrical and Electronics theories • Wiring techniques • Drawing interpretation • Soldering techniques • Principles of Instrumentation • Process variable measurements (pressure, level, flow, temperature, analysis, etc.) • Process Control Theory • Process Control System (single-loop & multi-loop controllers, DCS, DAS, SCADA, etc) • Sensors, transmitters, transducers & converters • Programmable logic controllers • Control valves and final control elements • Computer operations
Underpinning Skills	Include but not limited to: • Interpret Work Instructions • Interpret and Define Work Procedures • Selection and Use of Proper Tools and Equipment • Configuration Skills • Calibration skills • Problem Solving in Unplanned Events
Resource Implication	Include but not limited to: • Workplace location • instrumentation & control devices • tools • test equipment and calibrators • materials • PPE • technical manuals • instrumentation & control drawings
Method of Assessment	• Observation / Demonstration • Oral Questioning / written test
Context of Assessment	Assessment may be conducted in the workplace or in a simulated work environment

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Maintain and Repair Mechatronics Devices and Process Instrument**
Unit Code	**EEL MIS4 06 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes needed to maintain and repair mechatronics devices.

Elements	Performance Criteria
1. Plan and prepare for maintenance/ repair	1.1 Maintenance or repair work is planned and prepared in line with job requirements. 1.2 ***OH& S policies and procedures*** are followed in line with job requirements. 1.3 ***Mechatronics Device standards*** are identified in line with job requirements 1.4 ***Mechatronics devices*** to be maintained or repaired are identified based on job/service order or instructions 1.5 ***Mechatronics devices*** for maintenance or repair are checked against specifications and requirements. 1.6 ***Materials*** necessary to complete the work are obtained in accordance with established procedures and checked against job requirements. 1.7 ***Tools, equipment and testing devices*** needed for the maintenance/repair are obtained and checked for correct operation and safety
2. Maintain Mechatronics devices	2.1 Scheduled/periodic maintenance is performed in accordance with manufacturer's requirements 2.2 Normal function of mechatronics device is checked in accordance with manufacturer's instructions & standard procedures. 2.3 Necessary adjustments, replacement of components or parts of mechatronics and correction measures are responded appropriately. 2.4 Unplanned events or conditions are responded to in accordance with established procedures 2.5 Appropriate personal protective equipment is used as per OH&S procedure.
3. Repair Mechatronics devices	3.1 Normal function of mechatronics devices is checked in accordance with manufacturer's instructions. 3.2 Fault/s or problem/s in system or component is/are diagnosed in line with the standard operating procedures. 3.3 Necessary adjustments and other correction measures are

	responded appropriately 3.4 Unplanned events or conditions are responded in accordance with established procedures 3.5 Appropriate personal protective equipment is used in line with standard procedures.
4. Inspect and test maintained/repaired Mechatronics devices	4.1 Mechatronics devices are checked/ inspected to ensure safe operation 4.2 Conduct appropriate functional test(s) and inspection to ensure that the testing conducted on the device conforms with the manufacturer's instruction/manual 4.3 Test results are recorded in mechatronics devices history cards 4.4 Report is prepared and completed according to company requirements
5. Clean-up	5.1 Work site is cleaned and cleared of all debris and left in safe condition in accordance with company procedures

Variable	**Range**
OH & S policies and procedures	• OH & S guidelines • Ethiopian environmental proclamations and regulations
Mechatronics standards	Include but not limited to: • OIML (International Organization for Legal Metrology) Standards) or Ethiopian Standards (ES) • ISA (Instrumentation, Systems and Automation) Society (formerly Instrument Society of America) • ANSI (American National Standards Institute) • ASME (American Society of Mechanical Engineers) • NEC (National Electric Code) • IEC (International Electro technical Commission)
Mechatronics systems	Includes but not limited to: • Sensor elements • Electro-mechanical elements • Pneumatic & electro-pneumatic elements • Hydraulic elements • Electronic logic control elements • Robotic control elements • Actuators & output devices
Tools	Includes but not limited to: • Cutter • Shaper • Drill

	• Threading tool(assorted) • tapping • pliers (assorted) • screw drivers (assorted) • soldering iron/gun • wrenches
Equipment/testing devices	Includes but not limited to: • maintenance bench • instrument air supply equipment • power supply equipment • multi-meter • calibrators
Materials	include but not limited to: • sealing materials • pipes/tubes & fittings • wires and cables • cleaning materials • lubricating materials • spare parts or components
Personal protective equipment	Include but not limited to: • Ear muffs/plugs • Goggles/glasses/face shield • Safety belt/ harness • Safety shoes • Safety apparel/suit, hat, mask and gloves
Fault/s or problem/s	• mechanical • electrical • electronics • computer-based • pneumatic • hydraulics

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • interpreted work instructions according to job requirements • conducted maintenance properly on the devices using standard procedures • diagnosed faults on the devices • repaired or replaced defective components and/ or devices • configured or adjusted mechatronics device to the functional parameters or work requirements • checked the maintained/repaired devices to ensure safety • recorded maintenance/ repair results in history cards • reported the tasks undertaken
Underpinning Knowledge	Include but not limited to: • occupational health and safety • Mechatronics standards • Instrumentation and control device standards • use of tools and testing devices • mathematical calculations • electrical and electronics theories

	• measurement and calibration (metrological techniques) • wiring techniques • drawing interpretation • soldering techniques • principles of instrumentation • process variable measurements (pressure, level, flow, temperature, analysis, etc.) • process control theory • process control system (single-loop & multi-loop controllers, DCS, DAS, SCADA, etc) • sensors, transmitters, transducers & converters • programmable logic controllers • control valves and final control elements • computer operations • corrective & preventive maintenance procedures
Underpinning Skills	Include but not limited to: • Interpret work instructions • Interpret and define work procedures • Selection & use of proper tools & equipment • Diagnosing skills on device level • Problem solving in unplanned events • Recording and reporting maintenance/ repair activities
Resource Implication	Include but not limited to: • Workplace location • Mechatronics devices • Tools • Test equipment and calibrators • Materials and PPE • Technical manuals • Mechatronics drawings
Method of Assessment	• Observation / Demonstration • Oral Questioning / written test
Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Diagnose and Troubleshoot Mechatronics system**
Unit Code	**ELE MIS4 07 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitude needed to diagnose and troubleshoot defects in Mechatronics system

Elements	Performance Criteria
1. Plan and prepare for diagnosis of faults in Mechatronics systems	1.1 Diagnosis of faults is planned and prepared in line with job requirements 1.2 ***OH & S policies and procedures*** are followed in line with job requirements 1.3 Authorized personnel are consulted to coordinate the work effectively 1.4 ***Materials*** necessary are obtained in accordance with established procedures and job requirements 1.5 ***Tools, equipment and testing devices*** needed are obtained in accordance with job requirements and checked for proper operation and safety. 1.6 ***Mechatronics system*** faults are checked against job requirements.
2 Diagnose faults of Mechatronics systems	2.1 Appropriate ***personal protective equipment*** is used and OHS policies & procedures are followed 2.2 Fault or problem in the Mechatronics system is diagnosed in line with the standard operating procedures and technical requirements. 2.3 Contingency measures are managed and implemented in accordance with established procedures 2.4 Unplanned events or conditions are responded to in accordance with established procedures
3 Rectify/correct faults in the Mechatronics system	3.1 Appropriate personal protective equipment is used and OH & S policies & procedures are followed 3.2 Systems and associated equipment are isolated, where necessary, in accordance with established procedures 3.3 Defective components or parts are replaced or corrected without damage to the surrounding environment or services 3.4 Adjustments are made in accordance with established procedures, where necessary. 3.5 Unplanned events or conditions are responded to in accordance with established procedures.

4 Test the corrected Mechatronics system	4.1 Mechatronics system and associated equipment are tested using specified testing procedures from the manufacturer's instructions. 4.2 Mechatronics system and associated equipment are checked to ensure safe operation. 4.3 Unplanned events or conditions are responded to in accordance with established procedures. 4.4 Report/s are prepared/completed according to company requirements

Variable	**Range**
OH & S policies and procedures	• OH & S guidelines • Ethiopian environmental standards
Materials	Includes the following but not limited to: • Wires • Terminal lugs • Terminal wire marker • Terminal blocks
Tools	Includes the following but not limited to: • Pliers; assorted • Screwdrivers; assorted • Soldering iron
Test equipment/instruments	Includes the following but not limited to: • Multi-tester • Signal generator • Oscilloscope • Programmers or PC
Mechatronics Systems	Includes the following but not limited to: • Sensor elements • Electro-mechanical elements • Pneumatic & electro-pneumatic elements • Hydraulic elements • Electronic logic control elements • Robotic control elements • Actuators & output devices
Personal protective equipment	Include but not limited to: • Safety hat • Safety shoes • Ear muffs • Goggles • Safety belt/Harness • Gloves • Mask

Evidence Guide	
Critical aspects of competency	Assessment must show that the candidate: • Interpreted work instructions according to job the tasks undertaken • accurately diagnosed the defects in the mechatronics systems • properly adjusted/corrected the mechatronics systems identified • evaluated diagnosed results and rectified/ corrected systems • checked the diagnosed & corrected systems to insure safety • documented the tasks undertaken • followed OH & S procuders
Underpinning knowledge	Include but not limited to: • Occupational health and safety • Use of tools • Use of test equipment/instruments • Control circuits o Electro-mechanical o Pneumatic & electro-pneumatic o Hydraulic o Electronic logic • PLC operation & application • Human-machine interface/SCADA • Field and control devices • Basic Computer programming • PLC programming • Basic computer operations • Motion control systems • Vision systems
Underpinning skills	Include but not limited to: • Reading skills required to understand work Instructions • Diagram interpretation skills • Communication skills • Problem solving skills
Method of assessment	• The Assessor may select two of the following assessment methods to objectively assess the candidate: o Direct Observation o Oral Questioning o Third Party Report o Portfolio
Resource Implication	Include but not limited to: • Workplace location

	• Tools • Test instruments/equipment • PPE • Mechatronic equipment • Materials • Technical Manuals
Context of Assessment	• Assessment may be conducted in the workplace or in a simulated environment.

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Apply Problem Solving Techniques**
Unit Code	**ELE MIS4 08 0511**
Unit Descriptor	This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

Elements	Performance Criteria
1. Identify the problem	1.1 Variances are identified from normal operating parameters; and product quality 1.2 Extent, cause and nature are of the problem are defined through observation, investigation and analytical techniques 1.3 Problems are clearly stated and specified
2. Determine fundamental causes of the problem	2.1 Possible causes are identified based on experience and the use of problem solving tools **/** analytical techniques. 2.2 Possible cause statements are developed based on findings 2.3 Fundamental causes are identified per results of investigation conducted
3. Determine corrective action	3.1 All possible options are considered for resolution of the problem 3.2 Strengths and weaknesses of possible options are considered 3.3 Corrective actions are determined to resolve the problem and possible future causes 3.4 Action plans are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures
4. Provide recommendation / s to manager	4.1 Report on recommendations are prepared 4.2 Recommendations are presented to appropriate personnel 4.3 Recommendations are followed-up, if required

Variable	Range
Analytical techniques	• Brainstorming • Intuitions/Logic • Cause and effect diagrams • Pareto analysis • SWOT analysis • Gant chart, Pert CPM and graphs • Scatter grams
Problem	• Non – routine process and quality problems • Equipment selection, availability and failure • Teamwork and work allocation problem • Safety and emergency situations and incidents
Action plans	• Priority requirements • Measurable objectives • Resource requirements • Timelines • Co-ordination and feedback requirements • Safety requirements • Risk assessment • Environmental requirements

Evidence guide	
Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Identified the problem 1.2 Determined the fundamental causes of the problem 1.3 Determined the correct / preventive action 1.4 Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
Underpinning Knowledge	2.1 Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2 Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 2.3 Relevant equipment and operational processes 2.4 Enterprise goals, targets and measures 2.5 Enterprise quality, OHS and environmental requirement 2.6 Principles of decision making strategies and techniques 2.7 Enterprise information systems and data collation 2.8 Industry codes and standards

Underpinning Skills	3.1 Using range of formal problem solving techniques 3.2 Identifying and clarifying the nature of the problem 3.3 Devising the best solution 3.4 Evaluating the solution 3.1 Implementation of a developed plan to rectify the problem
Resource Implications	The following resources must be provided: Workplace or fully equipped assessment location with necessary tools and equipment as well as consumable materials Approved assessment tools
Methods of Assessment	Competence may be assessed through: Interview/Written Test Demonstration/Observation with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Occupational Standard: Instrumentation and Control Servicing Level IV	
Unit Title	**Conduct Loop Check**
Unit Code	**EEL MIS4 09 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes needed to check instrumentation and control loops (feedback loops in process controls).

Elements	Performance Criteria
1. Plan and prepare for loop checking control systems	1.1 **Control Systems** (loop) checking is planned and prepared in line with the job requirements. 1.2 ***OHS policies and procedures*** are followed in line with job requirements. 1.3 ***Instrumentation and Control standards*** are followed in line with the job requirements 1.4 Appropriate personnel are consulted to ensure that the work is effectively coordinated 1.5 Loop checking parameters are identified from appropriate documentation and/or requirements 1.6 ***Tools, equipment and testing devices*** needed for **control systems** checking are obtained and checked for correct operation and safety 1.7 ***Instrumentation and control loops*** to be checked are identified from the Job/Service Order or instructions 1.8 **Control Systems** checking is planned and prepared in line with job requirements
2. Conduct loop checking	2.1 Appropriate ***personal protective clothing*** is used in line with standard operating procedures 2.2 Devices' defects are diagnosed using specified testing procedures from manufacturer's manual 2.3 **Defect/s and fault/s** on the devices & loops are identified and reported in line with standard operating procedures. 2.4 Contingency measures are managed and implemented in accordance with established procedures

3. Test checked control systems	3.1 Instrumentation & control loops are tested to ensure safe operation 3.2 Unplanned events or conditions are responded to in accordance with established procedures 3.3 Test results are recorded 3.4 Report is prepared/ completed according to company procedures

Variable	Range
OH & S policies and procedures	• OH & S guidelines • Ethiopian environmental protection proclamations, regulations and standards
Instrumentation and Control Standards	Includes but not limited to: • Ethiopian building code standard EBCS -10 and EBCS-11, various Ethiopian ES on electrical materials and standards • Regulations for consumers' electrical installations, 1969, issued by Ethiopian Electric Light and Power Authority (EELPA), (now EEPCo) • OIML (International Organization for Legal Metrology Standards) or ES • ISA (Instrumentation, Systems and Automation) Society (formerly Instrument Society of America) • ANSI (American National Standards Institute) • ASME (American Society of Mechanical Engineers) • NEC (National Electrical Code) • IEC (International Electrotechnical Commission)
Tools	Tool set include but not limited to: • pliers (assorted) • screw drivers (assorted) • soldering iron/gun • wrenches • dismantling/assembling tools
Equipment/ testing devices	Equipment and testing devices include but not limited to: • communication equipment (e.g. 2-way radio, cell phone) • configurator or programmer • multimeter • calibrators • signal simulators • various instruments and control devices
Instrumentation and control loops	Include a combination of the following but not limited to: • sensors, transmitters and other measuring elements • indicators, recorders, controllers, annunciators, computer-based systems and other receiving elements • final control elements (control valves, dampers)

	• process and machineries
Personal protective equipment	Include but not limited to: • Ear muffs/plugs • Goggles/glasses/face shield • Safety hat • Safety apparel/suit • Safety belt/harness • Safety shoes • Mask • Gloves
Defect/s or fault/s	• mechanical • pneumatic • hydraulics • electrical • electronics • computer-based

Evidence Guide	
Critical Aspect of Competence	Assessment requires evidence that the candidate : • Interpreted work instructions according to job requirements. • Conducted loop-checks or control system accurately on the system using standard procedures • Tested the loop-checked system to insure safety • Documented the tasks undertaken
Underpinning Knowledge	Include but not limited to: • occupational health and safety • instrumentation & control standards • use of tools • mathematical calculations • electrical and electronics theories • use of test equipment and calibrators • wiring techniques • drawing interpretation • soldering techniques • principles of instrumentation • process variable measurements (pressure, level, flow, temperature, analysis, etc.) • process control theory • process control system (single-loop & multi-loop controllers, DCS, DAS, SCADA, etc) • sensors, transmitters, transducers & converters • programmable logic controllers • control valves and final control elements • computer operations • process and machinery operation
Underpinning Skills	• Interpret work instructions • Interpret and define work procedures • Selection & use of proper tools & equipment • Loop-checking skills • Problem solving in unplanned events
Resource	Include but not limited to: • Instrumentation & control devices

Implication	• Tools, Test equipment, calibrators, configurators or programmers • Materials, PPE and Technical manuals • Instrumentation & Control drawings
Assessment Methods	Competence may be assessed through: • Interview / Written exam / Oral questioning • Demonstration / Observation
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Install process instrumentation and control cabling and tubing**
Unit Code	**ELE IAC5 10 0511**
Unit Descriptor	This unit covers the installation and termination of instrument and control ***apparatus*** cabling and tubing for chemical, industrial or food processing systems. It encompasses working safely and to standards, routing cables and tubing to specified locations, terminating cables and tubing and connecting wiring at accessories and at instruments and control apparatus and completing the necessary installation documentation

Elements	Performance Criteria
1 .Prepare to install cabling and tubing	1.1 OH& S procedures for a given work area are identified, obtained and understood 1.2 Health and safety risks are identified, and established risk control measures and procedures in preparation for the work are followed. 1.3 Safety hazards that have not previously been identified are noted, and established risk control measures are implemented. 1.4 Installation of cabling and tubing is prepared in consultation with other affected by the work and sequenced appropriately. 1.5 The nature and location of the work is determined from documentation or appropriate person(s) to establish the scope of work to be undertaken. 1.6 Cable and tube routes are planned within the constraints of the building and plant structure, significant and regulations 1.7 Advice is sought from appropriate persons to ensure the work is coordinated effectively with others. 1.8 Material needed for the installation work is obtained in accordance with established procedures and checked against job requirements. 1.9 Tools, equipment and testing devices needed to for the installation work are obtained in accordance with established procedures and checked for correct operation and safety. 1.10 Preparatory work is checked to ensure no damage has occurred and that work complies with requirements.
2. Install cabling,	2.1 OH& S risk control measures and procedures for carrying out

tubing and accessories	the work are followed. 2.2 Plant/machines/equipment are checked as being isolated where necessary in strict accordance OH& S requirements and procedures 2.3 Cabling, tubing and accessories are installed to comply with technical standards and job specifications and requirements with sufficient excess to affect terminations. 2.4 Accessories are installed in the required locations and within acceptable tolerances. 2.5 Cables and conductors are terminated at accessories in accordance with manufacture's specifications and regulatory requirements 2.6 Tubing is terminated at accessories in accordance with manufacture's specifications and regulatory requirements 2.7 Established methods for dealing with unexpected situations are discussed with appropriate person or persons and documented. 2.8 Unexpected situations are dealt with safely and with the approval of an authorized person. 2.9 Ongoing checks of the quality of installed wiring are undertaken in accordance with established procedures. 2.10 Cabling and tubing installation is carried out efficiently without waste of materials and energy or damage to apparatus, the surrounding environment or services and using sustainable energy principles
3 Completion and report installation activities	3.1 OH& S work completion risk control measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 Final checks are made to that the installed wiring conforms to requirements. 3.4 'As-installed' cables, tubes and accessories are documented and appropriate person(s) notified in accordance with established procedures

Variables	Range
Apparatus	Include but not limited to: • Examples of wiring systems include armored cable; fire performance cables e.g. MIMS; thermoplastic insulated cable; thermoplastic sheathed cable; UTP, FTP, STP and coaxial communications cables. • Tubing types include low pressure metallic and non-metallic tubing and high pressure tubing

	Generic terms used throughout this Vocational Standard shall be regarded as part of the Range Statement in which competency is demonstrated.
Occupational Health & Safety (OH&S)	o Apply OH& S requirements in accordance with regulations/codes of practice and enterprise safety policies and procedures. This may include: o Using of relevant protective clothing and equipment, o use of tooling and equipment, workplace environment and safety handling of material, o use of fire fighting equipment, enterprise first aid, hazard control and hazardous materials and substances. o Using Chemical prove gowns, rubber boots of appropriate size, Goggles, respirators, helmet, and head phones , gloves etc, o Following Occupational health and safety procedures designated for the task o Checking and fulfilling required safety devices before starting operation o Apply safe operating procedures regarding: o electrical safety, o machinery movement and operation, o manual and mechanical lifting and shifting, o working in proximity to others and site visitors. o Apply emergency procedures : o emergency shutdown and stopping of equipment, o using extinguishing fires, first aid application and site evacuation
Tools and Equipment	o Electrician toolkit, mechanical toolkit, drill machine, bending machine, grinding machine, fixing and support device, riveter...
Material	Include but not limited to: • Occupational health and safety manual • Industry/workplace codes of practice • Organization operating procedures, • Safety work procedures/manual and material safety data sheets • Workplace guidelines/ workshop manuals • Manufacturer's diagrams, charts • Manufacturer's catalogue/specification manual. • Manufacturer's service and operation manuals • Design specification manual

	• Repair request documentation ,job cards, • Manufacturing and designing specifications and instructions • Records and reports • Virtual library

Evidence guide	Descriptions
Critical Aspects of Competence	Assessment requires evidence that the candidate: • A representative body of performance criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to: • Implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures as specified in the performance criteria and range statement • Apply sustainable energy principles and practices as specified in the performance criteria and range statement • Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements. • Demonstrate an appropriate level of skills enabling employment • Conduct work observing the relevant Anti Discrimination • legislation, regulations, polices and workplace procedures • Demonstrated consistent performance across a representative range of contexts from the prescribed items as listed as described in unit scope and including: below: • Install process instrumentation and control cabling and tubing • Reading and interpreting drawings related to cable and tube layouts, schedules and process control apparatus locations • Routing, placing and securing cables and tubing to comply with requirements • Placing and securing accessories accurately • Maintaining fire integrity • Terminating cables and tubing to comply with requirements • Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions

	incorporated in a holistic assessment with the above listed items
Underpinning knowledge	Include but not limited to: • Cables in buildings, structures and premises • Basic cable and conductor terminations • Electronic cable and conductor terminations • Technical standards, regulations and codes applicable to instrumentation and control • Occupational Health and Safety principles
Underpinning skill	Include but not limited to: • Pneumatic/hydraulic control tubing/piping • Instrumentation safe working practices
Resource Implications	Include but not limited to: • Workplace or fully equipped assessment location with necessary tools and equipment as well as consumable materials • Approved assessment tools • Certified assessor /Assessor's panel
Method of Assessment	Competency may be assessed through: • Practical assessment o Technical Interview/oral questioning o Practical demonstration o Simulation by off site practical test o Structured Observation of work • Theoretical exam • Supervisor report • Portfolio Assessment (Eg. Certificate from training providers)
Context of Assessment	• Competency may be assessed in the work place or in a simulated work place setting • The unit of competency should be assessed in conjunction with other relevant units in this occupation.

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Calibrate and test measuring instruments**
Unit Code	**EEL MIS4 11 0511**
Unit Descriptor	This unit covers calibration, adjustment and testing of measuring instruments. It encompasses working safely and to standards, following calibration and adjustment procedures, applying knowledge of parameters to be measured, testing and reporting

Elements	Performance Criteria
1. Prepare to calibrate and test measuring instruments	1.1 OH& S procedures for a given work area are identified, obtained and understood 1.2 Established OH& S risk control measures and procedures are followed in preparation for the work. 1.3 Safety hazards that have not previously been identified are noted, and established risk control measures are implemented. 1.4 Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved on the work site 1.5 Instrument parameters are determined by reviewing process specification and equipment manuals. 1.6 1.6 Tools, equipment and testing devices needed for the work are obtained in accordance with established procedures and checked for correct operation and safety
2 .Calibrate and test measuring instruments	1.1 OH& S risk control measures and procedures for carrying out the work are followed. 1.2 Calibration testing/measuring arrangement is connected and set up in accordance with manufacture's instructions and certification requirements for a particular instrument. 1.3 Factors effecting instrument error are determined and taken into account in the calibration process. 1.4 Instrument set-point is established and error adjustments are in accordance with manufacture's and compliance specification 1.5 Instrument is tested and adjustment made as necessary to ensure instrument meets calibration requirements. 1.6 Established methods for dealing with unexpected situations are discussed with appropriate person or

	persons and documented. 1.7 Unexpected situations are dealt with safely and with the approval of an authorized person. 1.8 Ongoing checks of the quality of process output are undertaken to ensure control loop is tuned as required. 1.9 Calibration is carried out efficiently without waste of materials or damage to apparatus, the surrounding environment or services and using sustainable energy principles.
3 .Completion and report calibration and test activities	3.1 OH& S risk control work completion measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 Calibration is documented in accordance with certification requirements

Variables	**Statements**
Occupational Health & Safety (OH&S)	Apply OH& S requirements in accordance with regulations/codes of practice and enterprise safety policies and procedures. This may include: o Using of relevant protective clothing and equipment, o use of tooling and equipment, o workplace environment and safety handling of material, o use of fire fighting equipment, enterprise first aid, o hazard control and hazardous materials and substances. o Using Chemical prove gowns, rubber boots of appropriate size, Goggles, respirators, helmet, and head phones , gloves etc, o Following Occupational health and safety procedures designated for the task o Checking and fulfilling required safety devices before starting operation Apply safe operating procedures regarding: o electrical safety, o machinery movement and operation, o manual and mechanical lifting and shifting, o working in proximity to others and site visitors. Apply emergency procedures : o emergency shutdown and stopping of equipment, o using extinguishing fires, first aid application and site evacuation

Tools, Equipment and material required	Electronics tool kit, multi meter, oscilloscope, mechanical toolkit, fixing and support devices, relevant pressure, temperature, level, motion, flow and calibration meters
Material	Include but not limited to: • Occupational health and safety manual • Industry/workplace codes of practice • Organization operating procedures, • Safety work procedures/manual and material safety data sheets • Workplace guidelines/ workshop manuals • Manufacturer's diagrams, charts • Manufacturer's catalogue/specification manual. • Manufacturer's service and operation manuals • Design specification manual • Repair request documentation ,job cards, • Manufacturing and designing specifications and instructions • Records and reports • Virtual library

Evidence guide	**Descriptions**
Critical Aspects of Competence	Assessment requires evidence that the candidate : • A representative body of performance criteria demonstrated within the timeframes typically expected of the discipline, work • function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to: • Implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures as specified in the performance criteria and range statement • Apply sustainable energy principles and practices as specified • in the performance criteria and range statement • Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the

	purpose of regulatory or licensing requirements. • Demonstrate an appropriate level of skills enabling employment • Conduct work observing the relevant Anti Discrimination legislation, regulations, polices and workplace procedures • Calibrate and test measuring instruments as listed as described in unit of scope and including: o Identifying instrument parameters o Setting up calibration arrangement in accordance with manufacture's instructions and certification requirements for a particular instrument. o Determining factors effecting error o Calibrating instrument to measure within specified tolerance o Documenting calibration with certification requirements o Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a holistic assessment with the above listed items
Underpinning knowledge	Include but not limited to: • Measurement standards applicable to scientific • instrumentation • Fundamentals of calibration • Calibration techniques • Occupational Health and Safety principles
Underpinning skill	Include but not limited to: • Instrumentation safe working practices • Problem solving in unplanned events
Resource Implications	Include but not limited to: • Workplace or fully equipped assessment location with necessary tools and equipment as well as consumable materials • Approved assessment tools Certified assessor /Assessor's panel
Method of Assessment	Competency may be assessed through: • Practical assessment o Technical Interview/oral questioning o Practical demonstration o Simulation by off site practical test o Structured Observation of work

	• Theoretical exam • Supervisor report • Portfolio Assessment (Eg Certificate from training providers)
Context of Assessment	• Competency may be assessed in the work place or in a simulated work place setting • The unit of competency should be assessed in conjunction with other relevant units in this occupation.

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Find and repair faults in measuring and analysis systems**
Unit Code	**ELE IAC5 12 0511**
Unit Descriptor	This unit covers finding and repairing faults in measuring, analysis and control systems. It encompasses working safely, reading circuit diagrams and device specifications, applying logical fault finding procedures, conducting repairs and completing the necessary service documentation.

Elements	Performance Criteria
1. Prepare to find and repair faults	1.1 OH& S procedures for a given work area are identified, obtained and understood 1.2 OH& S risk control measures and procedures are followed in preparation for the work. 1.3 The nature of the fault is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. 1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others. 1.5 Sources of materials that may be required for the work are established in accordance with established procedures. 1.6 Tools, equipment and testing devices needed to carry out the work are obtained in accordance with established procedures and checked for correct operation and safety.
2 Find and repair faults	2.1 OH& S risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OH& S requirements and when necessary conducted within established safety procedures. 2.3 Apparatus is checked as being isolated where necessary in strict accordance OH& S requirements and procedures. 2.4 Fault finding is approached methodically drawing on knowledge of measuring and analytical equipment and circuit using measured and calculated values of apparatus parameters. 2.5 Equipment components are dismantled where necessary and parts stored to protect them against loss or damage. 2.6 Faulty components are rechecked and their fault status confirmed.

	2.7 Faulty components are readjusted or replaced in accordance with established procedures. 2.8 Effectiveness of the repaired component is tested in accordance with established procedures. 2.9 Apparatus is reassembled, finally tested and prepared for return to customer. 2.10 Unexpected situations are dealt with safely and with the approval of an authorized person. 2.11 Fault finding and repair activities are carried out efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3. Completion and report fault finding and repair activities	3.1 OH& S work completion risk control measures and procedures are followed. 3.2 Work area is cleaned and made safe in accordance with established procedures. 3.3 Written justification is made for repairs to apparatus, including components and materials used. 3.4 Acceptance that the reported fault(s) have been repaired is sought from an appropriate person in accordance with established procedures.

Variables	**Range**
Occupational Health & Safety (OH& S)	Apply OH& S requirements in accordance with regulations/codes of practice and enterprise safety policies and procedures. This may include: o Using of relevant protective clothing and equipment, o use of tooling and equipment, o workplace environment and safety handling of material, o use of fire fighting equipment, enterprise first aid, o hazard control and hazardous materials and substances. o Using Chemical prove gowns, rubber boots of appropriate size, Goggles, respirators, helmet, and head phones , gloves etc, o Following Occupational health and safety procedures designated for the task o Checking and fulfilling required safety devices before starting operation Apply safe operating procedures regarding: o electrical safety, o machinery movement and operation, o manual and mechanical lifting and shifting,

	o working in proximity to others and site visitors. Apply emergency procedures : o emergency shutdown and stopping of equipment, o using extinguishing fires, first aid application and site evacuation
Tools and Equipment	Electronics tool kit, mechanical toolkit, portable power tool like drilling machine, fixing and support devices, electrical workshop machines
Material	Include but not limited to: • Occupational health and safety manual • Industry/workplace codes of practice • Organization operating procedures, • Safety work procedures/manual and material safety data sheets • Workplace guidelines/ workshop manuals • Manufacturer's diagrams, charts • Manufacturer's catalogue/specification manual. • Manufacturer's service and operation manuals • Design specification manual • Repair request documentation ,job cards, • Manufacturing and designing specifications and instructions • Records and reports • Virtual library

Evidence guide	**Descriptions**
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Implement Occupational Health and Safety workplace • procedures and practices, including the use of risk control measures as specified in the performance criteria and range statement • Apply sustainable energy principles and practices as specified in the performance criteria and range statement • Demonstrate an understanding of the essential knowledge and associated skills as described in this unit. It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements. • Demonstrate an appropriate level of skills enabling employment • Conduct work observing the relevant Anti

	Discrimination • legislation, regulations, polices and workplace procedures • range of contexts from the prescribed items below: o Using methodical fault finding techniques o Finding faults efficiently o Replacing components without damage o Providing written justification for the repairs o Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a holistic assessment with the above listed items
Underpinning knowledge	Include but not limited to: • Measurement circuits and applications • Gas analysis • Water analysis • Scientific analysis • Weight measurement principles • Occupational Health and Safety principles • Instrumentation safe working practices
Underpinning skill	Include but not limited to: • Measurement circuits and applications • Instrumentation safe working practices • Problem solving in unplanned events
Resource Implications	Include but not limited to: • Workplace or fully equipped assessment location with necessary tools and equipment as well as consumable materials • Approved assessment tools • Certified assessor /Assessor's panel
Method of Assessment	Competency may be assessed through: • Practical assessment o Technical Interview/oral questioning o Practical demonstration o Simulation by off site practical test o Structured Observation of work • Theoretical exam • Supervisor report • Portfolio Assessment (Eg Certificate from training providers)

Context of Assessment	• Competency may be assessed in the work place or in a simulated work place setting • The unit of competency should be assessed in conjunction with other relevant units in this occupation.

TOP

Occupational title: Mechatronics and Instrumentation Servicing Management Level IV	
Unit of Competency Title	**Find and repair faults in electrical apparatus and circuits**
Unit Code	**EEL IAC5 13 0511**
Unit Descriptor	This unit covers finding and repairing faults in electrical apparatus and interconnecting circuits and equipment operating at voltages up to 1,000 V a.c. or 1,500 V d.c. It encompasses working safely, reading circuit diagrams, and sketching diagrams from traced wiring, logically applying fault finding procedures, conducting repairs and completing the necessary service documentation.

Element	Performance criteria
1. Prepare to find and rectify faults.	1.1 The extent and nature of the electrical installation is determined from job specifications. 1.2 Safety and other regulatory requirements to which the electrical installation shall comply, areas are identified, obtained and understood. 1.3 OH& S procedures for a given work area are identified, obtained and understood. 1.4 OH& S risk control measures and procedures in preparation for the work are followed. 1.5 The likely extent of work to be undertaken is envisaged from fault/breakdown reports and/or discussions with appropriate person(s). 1.6 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.
2. Find and repair faults	2.1 OH& S risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OH& S requirements and when necessary conducted within established safety procedures. 2.3 Circuits/machines/plant are checked as being isolated where necessary in strict accordance OH& S requirements and procedures. 2.4 Safety hazards resulting from the fault or breakdown are documented and risk control measures devised and implemented in consultation with appropriate personnel. 2.5 Fault finding is approached methodically drawing on knowledge of a.c. circuits and apparatus using measured and calculated values of circuit/apparatus parameters. 2.6 Circuit/apparatus components are dismantled where

	necessary and parts stored to protect them against loss or damage. 2.7 Faulty circuits/components are rechecked and their fault status and acquired. 2.8 Materials/replacement parts required to rectify faults are sourced and obtained in accordance with established procedures. 2.9 Effectiveness of the repair is tested in accordance with established procedures. 2.10 Apparatus is reassembled, finally tested and prepared for return to service. 2.11 Unexpected situations are dealt with safely and with the approval of an authorized person. 2.12 Fault finding and repair activities are carried out without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.
3 Completion and report fault finding and repair activities	3.1 OH& S work completion risk control measures and procedures are followed. 3.2 Work area is cleaned and made safe in accordance with established procedures. 3.3 Written justification is made for repairs to apparatus. 3.4 Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Variables	**Range**
Emergency procedures	Include but not limited to: the isolation of electrical, mechanical, hydraulic, pneumatic and emergency steam and water equipment as appropriate
Workplace procedures	Include but not limited to: Standard Operating Procedures (SOPs), safety procedures, safety signs and symbols, labels, Material Safety Data Sheets (MSDSs), codes of practice, manufacturers' advice, standard forms and reports
Safe work procedures	Include but not limited to: relate to own work responsibilities and may include materials handling, working with hazardous goods, and special requirements such as working in confined spaces and at heights
Responsibility	Includes but not limited to:

	monitoring health and safety relates to the work area duties
Hazards	Include but not limited to: • noise • confined spaces • working with steam and hot services/product • airborne particulates • handling harmful substances • working with and near moving equipment/load shifting equipment • stress • broken or damaged equipment or materials • slip, trip and fall hazards • manual handling • working with 240V power supply • poor ventilation • working in exposed weather conditions • working with combustible materials
Work responsibilities	Include but not limited to: accountability for modeling appropriate OHS policies and procedures and may include formal or informal responsibility for providing a support role to others in the work area
Examples of OH& S procedures	include but not limited to: consultation and participation, emergency response, response to specific hazards, incident investigation, risk assessment, reporting arrangements and issue resolution procedures o working in exposed weather conditions o working with combustible materials
Tools and Equipment	Electronics tool kit, mechanical toolkit, portable power tool like drilling machine, fixing and support devices, electrical workshop machines
Material	Include but not limited to: • Relevant organizational policy, guidelines, procedures and protocols • Occupational code of conduct • Occupational health and safety guidelines and manuals • Manufacturer's operation and service manuals • Catalogue • Posters, brushers, etc

Evidence Guide	Description
Critical aspects of Assessment	Assessment requires evidence that the candidate: • Implement Occupational Health and Safety workplace procedures and practices, including the use of risk control measures as specified in the performance criteria and range statement • Apply sustainable energy principles and practices as specified in the performance criteria and range statement • Demonstrate an understanding of the essential knowledge and associated skills as described in this unit . It may be required by some jurisdictions that RTOs provide a percentile graded result for the purpose of regulatory or licensing requirements. • Demonstrate an appropriate level of skills enabling employment • Conduct work observing the relevant Anti Discrimination legislation, regulations, polices and workplace procedures • Manage risk in electro technology activities as described in unit of scope and including: o Identifying potential, perceived and actual risk events. o Using risk management methods, tools and techniques in analysis and reporting. o Incorporating risk management processes and procedures into program and project plans. o Monitoring and responding risk events effectively. o Identifying improvements and documenting recommendation for their inclusion in ongoing or future programs and projects. o Dealing with unplanned events by drawing on essential knowledge and skills to provide appropriate solutions incorporated in a holistic assessment with the above listed items.
Underpinning knowledge	Include but not limited to: • Enterprise communication methods • Enterprise work activities records • Fault finding techniques • Electrical control devices • Control circuit fundamentals • Technical standards regulations and codes for general electrical installations

	• Technical manuals and catalogues • Alternating current rotating machines • Single and three phase transformers • Lighting fundamentals • Luminaries and lighting systems • Electrical heating • Electrical installation wiring and accessories • Electrical installation protection methods and devices • Electrical installations, arrangement and equipment selection • Electromagnetic principles • Electronic components and systems, industrial applications • Occupational Health and Safety principles • Electrical Safe working practices
Underpinning Skills	Include but not limited to: • Interpret work instructions • Interpret and define work procedures • Selection and use of proper tools & equipment • Installation skills • Problem solving in unplanned events • Instrumentation safe working practices
Resource Implications	Include but not limited to: • Workplace or fully equipped assessment or simulated location with necessary tools and equipment as well as consumable materials includes: o OHS policy, system and procedures o Advice on OHS-related personnel and nominated responsibilities o Standard operating procedures and related advice on specific safe work practices o Advice on hazards and control procedures relevant to work responsibilities o Work tasks and related equipment to which OHS procedures are to be applied o Personal protective clothing and equipment as required o Emergency and/or evacuation procedures for the potential range of hazards o Storage areas for hazardous goods as required o Reporting system and procedures • Approved assessment tools

	• Certified assessor /Assessor's panel
Methods of assessment	Competency may be assessed through: • Practical assessment o Technical Interview/oral questioning o Practical demonstration o Simulation by off site practical test o Structured Observation of work • Theoretical exam • Supervisor report • Portfolio Assessment (Eg Certificate from training providers)
Context of assessment	• Competency may be assessed in the work place or in a simulated work place setting • The unit of competency should be assessed in conjunction with other relevant units in this occupation.

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Commission Mechatronics Systems**
Unit Code	**EEL MIS4 14 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes necessary to undertake the commissioning of mechatronics systems.

Elements	Performance Criteria
1 Plan and prepare to undertake commissioning process	1.1 Commissioning procedures are planned and prepared in line with job requirements. *1.2* ***OH & S policies and procedures*** are followed in line with job requirements. 1.3 Commissioning procedures are checked against specifications and requirements 1.4 ***Tools*****, *equipment* and *testing devices*** needed are obtained and checked for correct operation and safety. 1.5 ***Materials*** necessary are obtained in accordance with job requirements
2 Commission Mechatronics systems	2.1 Appropriate ***personal protective equipment*** is used and OHS policies & procedures are followed. 2.2 Mechatronics systems are checked using specified procedures 2.3 Commissioning procedure is performed in accordance with requirements without damage to the surrounding environment or services 2.4 Unplanned events or conditions are responded to in accordance with established procedures
3 Test commissioned Mechatronics systems	3.1 Commissioned Mechatronics systems are tested according to established procedures or manufacturer's instructions. 3.2 Unplanned events or conditions are responded to in accordance with established procedures. 3.3 Report on the commissioning process is prepared according to the company requirements.

Variable	Range
OH & S policies and procedures	• OH & S guidelines • Ethiopian environmental protection proclamations, regulations and standards

Mechatronics systems	Includes the following but not limited to: • Sensor elements • Electro-mechanical elements • Pneumatic & electro-pneumatic elements • Hydraulic elements • Electronic logic control elements • Robotic control elements • Actuators & output devices
Tools	Includes the following but not limited to: • Pliers; assorted • Screwdrivers; assorted • Soldering iron
Test equipment/instruments	Includes the following but not limited to: • Multi-tester • Signal generator • Oscilloscope • Programmer or PC
Materials	Includes the following but not limited to: • Wires • Terminal lugs • Terminal wire marker • Terminal blocks
Personal protective equipment	• Safety hat • Safety shoes • Ear muffs • Goggles • Safety belt/Harness • Gloves • Mask

Evidence Guide	
Critical aspects of competency	Assessment must show that the candidate: • Interpreted work instructions according to job requirements. • Applied the appropriate/correct procedures in commissioning Mechatronics systems • Checked and tested the commissioned Mechatronics systems according to procedures & manufacturer's instructions
Underpinning knowledge	Include but not limited to: • Occupational health and safety • Use of tools

	• Use of test equipment/instruments • Control circuits o Electro-mechanical o Pneumatic & electro-pneumatic o Hydraulic o Electronic logic • PLC operation & application • Human-machine interface/SCADA • Field and control devices • Basic Computer programming • PLC programming • Basic computer operations • Motion control systems • Vision systems
Underpinning skills	Include but not limited to: • Reading skills required to understand work Instructions • Diagram interpretation skills • Communication skills • Problem solving skills
Method of assessment	• The Assessor may select two of the following assessment methods to objectively assess the candidate: o Direct Observation o Questioning – written and/or oral o Third party Report o Portfolio
Resource Implication	Include but not limited to: • Workplace location • Tools • Test equipment/instruments • PPE • Materials • Mechatronics equipment • Technical Manuals
Context of Assessment	• Assessment may be conducted in the workplace or in a simulated environment

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Develop Individuals and Teams**
Unit Code	**EEL MIS4 15 0511**
Unit Descriptor	This unit covers the skills, knowledge and attitudes required to determine individual and team development needs and facilitate the development of the workgroup.

Elements	Performance Criteria
1. Provide team leadership	1.1 ***Learning and development needs*** are systematically identified and implemented in line with ***organizational requirements*** 1.2 Learning plan to meet individual and group training and developmental needs is collaboratively developed and implemented 1.3 Individuals are encouraged to self evaluate performance and identify areas for improvement 1.4 ***Feedback on performance*** of team members is collected from relevant sources and compared with established team learning process
2. Foster individual and organizational growth	2.1 Learning and development program goals and objectives are identified to match the specific knowledge and skills requirements of Competence standards 2.2 ***Learning delivery methods*** are appropriate to the learning goals, the learning style of participants and availability of equipment and resources 2.3 Workplace learning opportunities and coaching/ mentoring assistance are provided to facilitate individual and team achievement of competencies 2.4 Resources and timelines required for learning activities are identified and approved in accordance with organizational requirements

3. Monitor and evaluate workplace learning	3.1 Feedback from individuals or teams is used to identify and implement improvements in future learning arrangements 3.2 Outcomes and performance of individuals/teams are assessed and recorded to determine the effectiveness of development programs and the extent of additional support 3.3 Modifications to learning plans are negotiated to improve the efficiency and effectiveness of learning 3.4 Records and reports of Competence are maintained within organizational requirement
4. Develop team commitment and cooperation	4.1 Open communication processes to obtain and share information is used by team 4.2 Decisions are reached by the team in accordance with its agreed roles and responsibilities 4.3 Mutual concern and camaraderie are developed in the team
5. Facilitate accomplishment of organizational goals	5.1 Team members actively participated in team activities and communication processes 5.2 Teams members developed individual and joint responsibility for their actions 5.3 Collaborative efforts are sustained to attain organizational goals

Variable	**Range**
Learning and development needs	• Coaching, monitoring and/or supervision • Formal/informal learning program • Internal/external training provision • Work experience/exchange/opportunities • Personal study • Career planning/development • Performance evaluation • Workplace skills assessment • Recognition of prior learning
Organizational requirements	• Quality assurance and/or procedures manuals • Goals, objectives, plans, systems and processes • Legal and organizational policy/guidelines and requirements • Safety policies, procedures and programs • Confidentiality and security requirements • Business and performance plans • Ethical standards • Quality and continuous improvement processes and standards
Feedback on performance	• Formal/informal performance evaluation • Obtaining feedback from supervisors and colleagues • Obtaining feedback from clients

	• Personal and reflective behavior strategies • Routine and organizational methods for monitoring service delivery
Learning delivery methods	• On the job coaching or monitoring • Problem solving • Presentation/demonstration • Formal course participation • Work experience • Involvement in professional networks • Conference and seminar attendance
Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Identified and implemented learning opportunities for others • Gave and received feedback constructively • Facilitated participation of individuals in the work of the team • Negotiated plans to improve the effectiveness of learning • Prepared learning plans to match skill needs • Accessed and designated learning opportunities
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • coaching and monitoring principles • understanding how to work effectively with team members who have diverse work styles, aspirations, cultures and perspective • understanding how to facilitate team development and improvement • understanding methods and techniques to obtain and interpreting feedback • understanding methods for identifying and prioritizing personal development opportunities and options • knowledge of career paths and competence standards in the industry
Underpinning Skills	Demonstrates skills to: • ability to read and understand a variety of texts, prepare general information and documents according to target audience; spell with accuracy; use grammar and punctuation effective relationships and conflict management • communication skills including receiving feedback and reporting, maintaining effective relationships and conflict management • planning skills to organize required resources and equipment to meet learning needs • coaching and mentoring skills to provide support to colleagues • reporting skills to organize information; assess information for relevance and accuracy; identify and elaborate on learning outcomes • facilitation skills to conduct small group training sessions

	• ability to relate to people from a range of social, cultural, physical and mental backgrounds
Resource Implications	Access to relevant workplace or appropriately simulated environment where assessment can take place
Assessment Methods	Competence may be accessed through: • Interview / Written test • Observation / Demonstration
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Utilize Specialized Communication Skills**
Unit Code	**EEL MIS4 16 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to use specialized communication skills to meet specific needs of internal and external clients, conduct interviews, facilitate group discussions, and contribute to the development of communication strategies.

Elements	Performance Criteria
1. Meet common and specific communication needs of clients and colleagues	1.1 Specific communication needs of clients and colleagues are identified and met 1.2 Different approaches are used to meet communication needs of clients and colleagues 1.3 Conflict is addressed promptly and in a timely way and in a manner which does not compromise the standing of the organization
2. Contribute to the development of communication strategies	2.1 ***Strategies*** for internal and external dissemination of information are developed, promoted, implemented and reviewed as required 2.2 Channels of communication are established and reviewed regularly 2.3 Coaching in effective communication is provided 2.4 Work related network and relationship are maintained as necessary 2.5 Negotiation and conflict resolution strategies are used where required 2.6 Communication with clients and colleagues is appropriate to individual needs and organizational objectives

3. Represent the organization	3.1 When participating in internal or external forums, presentation is relevant, appropriately researched and presented in a manner to promote the organization 3.2 Presentation is clear and sequential and delivered within a predetermined time 3.3 Utilize appropriate media to enhance presentation 3.4 Differences in views are respected 3.5 Written communication is consistent with organizational standards 3.6 Inquiries are responded in a manner consistent with organizational standard
4. Facilitate group discussion	4.1 Mechanisms which enhance ***effective group interaction*** is defined and implemented 4.2 Strategies which encourage all group members to participate are used routinely 4.3 Objectives and agenda for meetings and discussions are routinely set and followed 4.4 Relevant information is provided to group to facilitate outcomes 4.5 Evaluation of group communication strategies is undertaken to promote participation of all parties 4.6 Specific communication needs of individuals are identified and addressed
5. Conduct interview	5.1 A range of appropriate communication strategies are employed in ***interview situations*** 5.2 Records of interviews are made and maintained in accordance with organizational procedures 5.3 Effective questioning, listening and nonverbal communication techniques are used to ensure that required message is communicated

Variable	**Range**
Strategies	• Recognizing own limitations • Utilizing techniques and aids • Providing written drafts • Verbal and non verbal communication
Effective group interaction	• Identifying and evaluating what is occurring within an interaction in a non judgmental way • Using active listening • Making decision about appropriate words, behavior • Putting together response which is culturally appropriate • Expressing an individual perspective • Expressing own philosophy, ideology and background and exploring impact with relevance to communication

Types of Interview	• Related to staff issues • Routine • Confidential • Evidential • Non-disclosure • Disclosure
Interview situations	• Establish rapport • obtain facts and information • Facilitate resolution of issues • Develop action plans • Diffuse potentially difficult situation

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Demonstrated effective communication skills with clients accessing service and work colleagues • Adopted relevant communication techniques and strategies to meet client particular needs and difficulties
Underpinning Knowledge and Values	Demonstrates knowledge of: • Communication process • Dynamics of groups and different styles of group leadership • Communication skills relevant to client groups
Underpinning Skills	Demonstrates skills of: • Full range of communication techniques including: ▪ Full range of communication ▪ Active listening ▪ Feedback ▪ Interpretation ▪ Role boundaries setting ▪ Negotiation ▪ Establishing empathy • Communication skills required to fulfill job roles as specified by the organization
Resource Implications	The following resources must be provided: • Workplace or fully equipped assessment location with necessary tools and equipment as well as consumable materials
Methods of Assessment	Competence may be assessed through: • Observation / demonstration with oral questioning • Interview / written test
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics & Instrumentation Servicing Management Level IV	
Unit Title	**Establish Quality Standards**
Unit Code	**EEL MIS4 17 0511**
Unit Descriptor	This unit covers the knowledge, attitudes and skills required to monitor quality of work, establish quality specifications for work outcomes, participate in maintaining and improving quality at work, identify hazards and critical control points in the production of quality output, assist in planning of quality assurance procedures, report problems that affect quality and implement quality assurance procedures.

Elements	Performance Criteria
1. Establish quality specifications for service	1.1 Market specifications are **sourced** and ***legislated requirements*** identified. 1.2 Quality specifications developed and agreed upon 1.3 Quality specifications are documented and introduced to organization staff / personnel in accordance with the organization policy 1.4 Quality specifications are updated when necessary
2. Identify hazards and critical control points	2.1. Critical control points impacting on quality are identified. 2.2. Degree of risk for each hazard is determined. 2.3. Necessary documentation is accomplished in accordance with organization quality procedures
3. Assist in planning of quality assurance procedures	3.1 Procedures for each identified control point are developed to ensure optimum quality. 3.2 Hazards and risks are minimized through application of appropriate controls. 3.3 Processes to monitor the effectiveness of quality assurance procedures are developed.
4. Implement quality assurance procedures	4.1 Responsibilities for carrying out procedures are allocated to staff and contractors. 4.2 Instructions are prepared in accordance with the enterprise's quality assurance program. 4.3 Staff and contractors are given induction training on the quality assurance policy. 4.4 Staff and contractors are given in-service training relevant to their allocated procedures.
5. Monitor quality of work outcome	5.1 Quality requirements are identified 5.2 Inputs are inspected to confirm capability to meet quality requirements

	5.3 Work is conducted to produce required outcomes 5.4 Work processes are monitored to confirm quality of output and/or service 5.5 Processes are adjusted to maintain outputs within specification.
6. Participate in maintaining and improving quality at work	6.1 Work area, ***materials***, ***tool and equipment***, processes and product are routinely monitored to ensure compliance with quality requirements 6.2 Non-conformance in inputs, process, product and/or service is identified and reported according to workplace reporting requirements 6.3 Corrective action is taken within level of responsibility, to maintain quality standards 6.4 Quality issues are raised with designated personnel
7. Report problems that affect quality	7.1 Recognize potential or existing quality problems. 7.2 Identify instances of variation in quality from specifications or work instructions. 7.3 Report variation and potential problems to supervisor/manager according to enterprise guidelines.

Variables	**Range**
Sourced	• end-users • customers or stakeholders
Legislated requirements	• Verification of service quality as part of consumer legislation or specific legislation related to service content or composition.
Safety procedures	• use of tools and equipment for construction works • workplace environment and handling of material safety, • following occupational health and safety procedures designated for the task • respect the policies, regulations, legislations, rule and procedures for construction works
Materials	• gloves, bucket, scrubbing brush, gauze, cotton and plasters • aluminum foils, gowns, apron, rubber boots, disinfectants, antiseptics, scalpel blade, stationeries, tap water, alcohol, and soap, detergents, protective eyewear, overall, cleaning reagents cleaning materials
Tools and Equipment	• projector, white board, computers, printers, calculators, copying machines, bucket, wheelbarrow/trolley for disposal of carcass, different quality evaluating equipment

Evidence Guide	
Critical Aspect of Competence	Assessment requires evidence that the candidate: • Monitored quality of work • Established quality specifications for service • Participated in maintaining and improving quality at work • Identified hazards and critical control points in the production of quality service • Assisted in planning of quality assurance procedures • Reported problems that affect quality • Implemented quality assurance procedures
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Monitoring quality of work • Establishing quality specifications for product • Participating in maintaining and improving quality at work • Identifying hazards and critical control points in the production of quality product • Assisting in planning of quality assurance procedures • Reporting problems that affect quality • Implementing quality assurance procedures
Underpinning Skills	Demonstrates skills in: • Monitoring quality of work • Establishing quality specifications for service • Participating in maintaining and improving quality at work • Identifying hazards and critical control points in the production of quality service • Assisting in planning of quality assurance procedures • Reporting problems that affect quality • Implementing quality assurance procedures
Resource Implications	The following resources must be provided: • Workplace or fully equipped environment with necessary tools and equipment as well as consumable materials
Assessment Methods	Competence may be assessed through: • interview/ Written Test • Demonstration/Observation with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics & Instrumentation Servicing Management Level IV	
Unit Title	**Manage and Maintain Small/Medium Business Operation**
Unit Code	**EEL MIS4 18 0511**
Unit Descriptor	This unit covers the operation of day-to-day business activities in a micro or small business. The strategies involve developing, monitoring and managing work activities and financial information, developing effective work habits, and adjusting work schedules as needed.

Elements	Performance Criteria
2. Identify daily work requirements	1.1 Work requirements for a given time period are identified taking into consideration ***resources*** and constraints 1.2 Work activities are prioritized based on business needs, requirements and deadlines 1.3 If appropriate, work is allocated to relevant staff or contractors to optimize efficiency
3. Monitor and manage work	2.1 People, resources and/or equipment are coordinated to provide optimum results 2.2 Staff, clients and/or contractors are communicated within a clear and regular manner, to monitor work in relation to ***business goals*** or timelines 2.3 ***Problem solving techniques*** are applied to work situations to overcome difficulties and achieve positive outcomes
4. Develop effective work habits	3.1 Work and personal priorities are identified and a balance is achieved between competing priorities using appropriate ***time management strategies*** 3.2 Input from ***internal and external sources*** is sought and used to develop and refine new ideas and approaches 3.3 Business or inquiries are responded to promptly and effectively 3.4 Information is presented in a format appropriate to the industry and audience
5. Interpret financial information	4.1 Relevant documents and reports are identified 4.2 Documents and reports are read and understood and any implications discussed with appropriate persons 4.3 Data and numerical calculations are analyzed, checked, evaluated, organized and reconciled

	4.4 Daily financial records and cash flow are maintained correctly and in accordance with legal and accounting requirements 4.5 Invoices and payments are prepared and distributed in a timely manner and in accordance with legal requirements 4.6 Outstanding accounts are collected or followed-up on
6. Evaluate work performance	5.1 Opportunities for improvements are monitored according to business demands 5.2 Work schedules are adjusted to incorporate necessary modifications to existing work and routines or changing needs and requirements 5.3 Proposed changes are clearly communicated and recorded to aid in future planning and evaluation 5.4 Relevant codes of practice are used to guide an ethical approach to workplace practices and decisions

Variables	**Range**
Resources may include:	• staff • money • time • equipment • space
Business goals may include:	• sales targets • budgetary targets • team and individual goals • production targets • reporting deadlines
Problem solving techniques may include:	• gaining additional research and information to make better informed decisions • looking for patterns • considering related problems or those from the past and how they were handled • eliminating possibilities • identifying and attempting sub-tasks • collaborating and asking for advice or help from additional sources
Time management strategies may include:	• prioritizing and anticipating • short term and long term planning and scheduling • creating a positive and organized work environment • clear timelines and goal setting that is regularly reviewed and adjusted as necessary • breaking large tasks into smaller tasks • getting additional support if identified and necessary
Internal and	• staff and colleagues

external sources may include:	• management, supervisors, advisors or head office • relevant professionals such as lawyers, accountants, management consultants • professional associations

Evidence Guide	
Critical Aspects of Competence	A person must be able to demonstrate: • ability to identify daily work requirements and allocate work appropriately • ability to interpret financial documents in accordance with legal requirements
Underpinning Knowledge and Attitudes	• Federal and Local Government legislative requirements affecting business operations, especially in regard to occupational health and safety (OH&S), equal employment opportunity (EEO), industrial relations and anti-discrimination • technical or specialist skills relevant to the business operation • relevant industry code of practice • planning techniques to establish realistic timelines and priorities • identification of relevant performance measures • quality assurance principles and methods • relevant marketing, management, sales and financial concepts • methods for monitoring performance and implementing improvements • structured approaches to problem solving, idea management and time management
Underpinning Skills	• literacy skills to interpret legal requirements, company policies and procedures and immediate, day-to-day demands • communication skills including questioning, clarifying, reporting, and giving and receiving constructive feedback • numeracy skills for performance information, setting targets and interpreting financial documents and reports • technical and analytical skills to interpret business documents, reports and financial statements and projections • ability to relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities • problem solving skills to develop contingency plans • using computers and software packages to record and manage data and to produce reports • evaluation skills for assessing work and outcomes • observation skills for identifying appropriate people, resources and to monitor work
Resource Implications	The following resources should be provided: • Access to relevant workplace documentation, financial records, and equipment
Methods of Assessment	Competence may be assessed through: • Interview / Written Test

	• Observation/Demonstration with Oral questioning
Context for Assessment	Competence may be assessed in the workplace or in a simulated work environment

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Migrate to New Technology**
Unit Code	**EEL MIS4 19 0511**
Unit Descriptor	This unit defines the competence required to apply skills and knowledge in using new or upgraded technology. The rationale behind this unit emphasizes the importance of constantly reviewing work processes, skills and techniques in order to ensure that the quality of the entire business process is maintained at the highest level possible through the appropriate application of new technology. To this end, the person is typically engaged in on-going review and research in order to discover and apply new technology or techniques to improve aspects of the organization's activities.

Elements	Performance Criteria
1. Apply existing knowledge and techniques to technology and transfer	1.1 Situations are identified where existing knowledge can be used as the basis for developing new skills. 1.2 New or upgraded technology skills are acquired and used to enhance learning. 1.3 New or upgraded equipment are identified, classified and used where appropriate, for the benefit of the organization.
2. Apply functions of technology to assist in solving organizational problems	2.1 Testing of new or upgraded equipment is conducted according to the specification manual. 2.2 Features of new or upgraded equipment are applied within the organization 2.3 Features and functions of new or upgraded equipment is used for solving organizational problems 2.4 Sources of information is accessed and used relating to new or upgraded equipment
3. Evaluate new or upgraded technology performance	3.1 New or upgraded equipment is evaluated for performance, usability and against OHS standards**.** 3.2 ***Environmental considerations*** are determined from new or upgraded equipment. 3.3 ***Feedback*** is sought from users where appropriate.

Variables	Range
Environmental Considerations	May include but is not limited to recycling, safe disposal of packaging (e.g. cardboard, polystyrene, paper, plastic) and correct disposal of waste materials by an authorized body
Feedback	May include surveys, questionnaires, interviews and meetings.

Evidence Guide	
Critical Aspects of Competence	Competence must confirm the ability to transfer the application of existing skills and knowledge to new technology
Underpinning Knowledge and Attitudes	• Broad awareness of current technology trends and directions in construction industry (e.g. systems/procedures, services, new developments, new protocols) • Knowledge of vendor product directions • Ability to locate appropriate sources of information regarding building construction and new technologies • Current industry products/services, procedures and techniques with knowledge of general features • Information gathering techniques
Underpinning Skills	• Research skills for identifying broad features of new technologies • Ability to assist in the decision making process • Literacy skills in regard to interpretation of technical manuals • Ability to solve known problems in a variety of situations and locations • Evaluate and apply new technology to assist in solving organizational problems • General analytical skills in relation to known problems
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Assessment Methods	Competency may be assessed through: • Interview / Written Test • Demonstration/ Observation with Oral Questioning
Context of Assessment	Competency may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Mechatronics and Instrumentation Servicing Management Level IV	
Unit Title	**Manage Continuous Improvement System**
Unit Code	**EEL MIS4 20 1012**
Unit Descriptor	This unit describes the performance outcomes, skills and knowledge required to sustain and develop an environment in which continuous improvement, innovation and learning are promoted and rewarded.

Elements	Performance Criteria
1. Review programs, systems and processes	1.1 Establish strategies to monitor and evaluate performance of key systems and processes 1.2 Undertake detailed analyses of supply chains, operational and product/service delivery systems 1.3 Identify performance measures, and assessment tools and techniques, and evaluate their effectiveness 1.4 Analyze performance reports and variance from plans for all key result areas of the organization 1.5 Identify and analyze changing trends and opportunities relevant to the organization 1.6 Seek advice from specialists, where appropriate, to identify technology and electronic commerce opportunities
2. Develop options for continuous improvement	2.1 Brief groups on performance improvement strategies and innovation as an essential element of competition 2.2 Foster ***creative climate*** and ***organizational learning*** through the promotion of interaction within and between work groups 2.3 Encourage, test and recognize new ideas and entrepreneurial behavior where successful 2.4 Accept failure of an idea during trialing, and recognize, celebrate and embed success into systems 2.5 Undertake ***risk management*** and ***cost benefit analyses*** for each option/idea approved for trial 2.6 Approve innovations through agreed organizational processes
3. Implement innovative processes	3.1 Promote continuous improvement as an essential part of doing business 3.2 Address impact of change and consequences for people, and implement transition plans

	3.3 Ensure objectives, timeframes, measures and communication plans are in place to manage implementation 3.4 Implement contingency plans in the event of non-performance 3.5 Follow-up failure by prompt investigation and analysis of causes 3.6 Manage emerging challenges and opportunities effectively 3.7 Evaluate continuous improvement systems and processes regularly 3.8 Communicate costs and benefits of innovations and improvements to all relevant groups and individuals

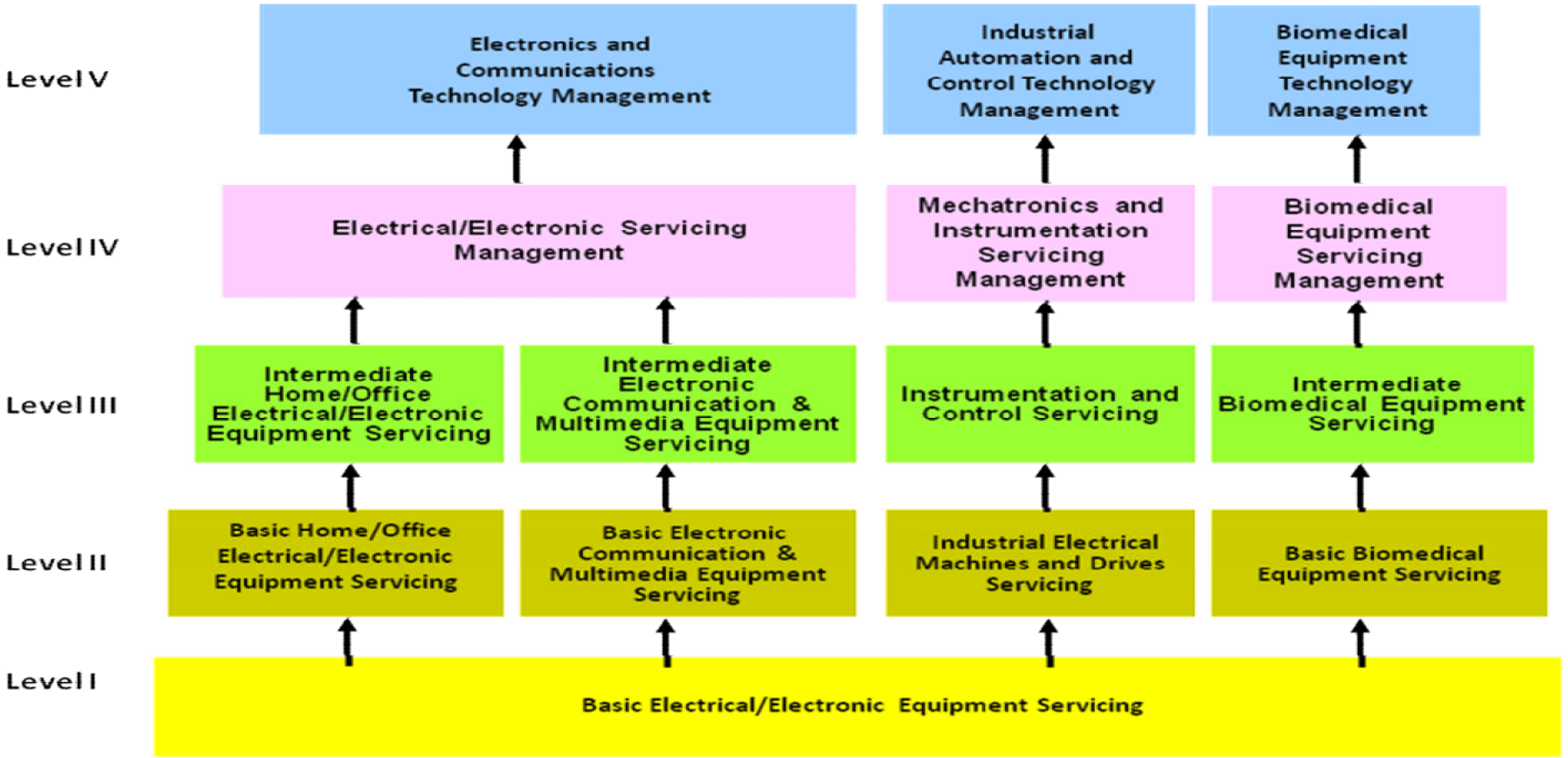
Variable	**Range**
Sustainability may include:	• addressing environmental and resource sustainability initiatives, such as environmental management systems, action plans, green office programs, surveys and audits • applying the waste management hierarchy in the workplace • complying with regulations and corporate social responsibility considerations for sustainability to enhance the organisation's standing in business and community environments • determining organisation's most appropriate waste treatment, including waste to landfill, recycling, re-use, recoverable resources and wastewater treatment • implementing ecological footprint • implementing environmental management systems, e.g. ISO 14001:1996 Environmental management systems life cycle analyses • implementing government initiatives, • improving resource and energy efficiency • initiating and maintaining appropriate organisational procedures for operational energy consumption • introducing a green office program - a cultural change program • introducing green purchasing • introducing national and international reporting initiatives, • introducing product stewardship • reducing emissions of greenhouse gases • reducing use of non-renewable resources • referencing standards, guidelines and approaches, such as sustainability covenants and compacts or triple bottom line reporting • supporting sustainable supply chain.

Supply chains include:	• network of facilities that procures raw materials, transforms them into intermediate products or services and then finished goods or service, and delivers them through a distribution system • procurement, production and distribution, viewed as interlinked not as discrete elements
Performance reports may include:	• budget or cost variance • customer service • environmental • financial • OHS • quality • other operating parameters

Evidence Guide	
Critical Aspects of Competence	Evidence of the following is essential: • demonostration of consultation processes to introduce or evaluate an existing continuous improvement process or system, including suggested actions or an action plan • generation of an idea or concept which exhibits creative thinking and which offers the possibility of advantaging the organization • how the concept or idea was introduced, tested and evaluated - the idea or concept does not have to have been shown to work or to be adopted by the business • knowledge of quality management and continuous improvement theories
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • quality management and continuous improvement theories • creativity/innovation theories/concepts • risk management • cost-benefit analysis methods • creativity and innovation theories and concepts • organizational learning principles • quality management and continuous improvement theories • risk management • sustainability practices
Underpinning Skills	Demonstrates skills to: • analytical skills to identify improvement opportunities in relation to • the services/products delivered or concepts/ideas developed • flexibility and creativity skills to think laterally • leadership skills to foster a commitment to quality and an openness to innovation • teamwork and leadership skills to foster a commitment to

	quality and an openness to innovation
Resources Implication	Access may be required to: • workplace procedures and plans relevant to work area • appropriate documentation and resources normally used in the workplace
Methods of Assessment	Competence in this unit may be assessed by using a combination of the following to generate evidence: • demonstration in the workplace • suitable simulation • oral or written questioning to assess knowledge of principles and techniques associated with change management • evaluation of strategies established to monitor and evaluate performance of key systems and processes • review of briefing of groups on performance improvement strategies and innovation Those aspects of competence dealing with improvement processes could be assessed by the use of suitable simulations and/or a pilot plant and/or a range of case studies and scenarios. In all cases, practical assessment should be supported by questions to assess essential knowledge and those aspects of competence which are difficult to assess directly.
Context of Assessment	Competence may be assessed in the work place or in a simulated workplace setting / environment.

Sector: Electrotechnology and Telecommunication
Sub-Sector: Electrotechnology



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