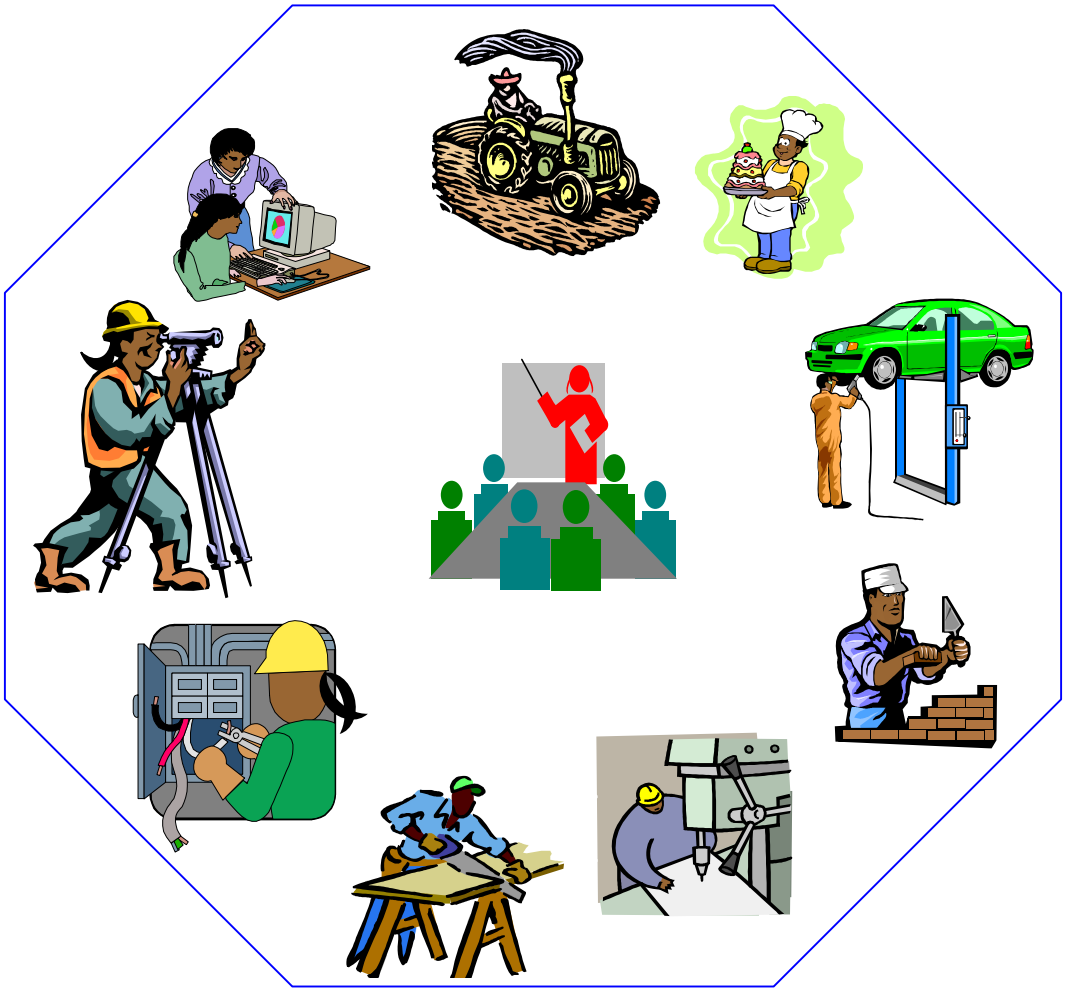
Federal Democratic Republic of Ethiopia

OCCUPATIONAL STANDARD

BIOMEDICAL EQUIPMENT SERVICING MANAGEMENT

NTQF Level IV



Ministry of Education

May 2011

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: Biomedical Equipment Servicing Management

Occupational Code:

NTQF Level IV

EEL BES4 01 0511 Install Advanced Biomedical Equipment	EEL BES4 02 0511 Plan and Organize Work	EEL BES4 03 0511 Manage Biomedical Equipment
EEL BES4 04 0511 Perform Technical Consultation	EEL BES4 05 0511 Maintain and Repair Advanced Biomedical Equipment	EEL BES4 06 0511 Train Biomedical Equipment End Users
EEL BES4 07 0511 Apply Problem Solving Techniques	EEL BES4 08 0511 Find and Repair Faults in Measuring and Analysis Systems	EEL BES4 09 0511 Configure and Calibrate Biomedical Equipment
EEL BES4 10 0511 Establish Quality Systems and Procedures	EEL BES4 11 0511 Develop Individual and Teams	EEL BES4 12 0511 Utilize Specialized Communication Skills
EEL BES4 13 0511 Manage and Maintain Small/Medium Business Operations	EEL BES4 14 0511 Migrate to New Technology	EEL BES4 15 1012 Manage Continuous Improvement System

TOP

Occupational Standard: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Install Advanced Biomedical Equipment**
Unit Code	**EEL BES4 01 0511**
Unit Descriptor	This unit covers the advanced knowledge, skills and attitudes necessary to install biomedical equipment.

Elements	Performance Criteria
1. Interpret work instructions	1.1 Work instructions are read and interpreted to determine job requirements 1.2 ***Tools*** and ***testing devices*** needed to carry out the installation work are selected in accordance with established procedures and checked for correct operation and safety 1.3 ***Materials*** necessary to complete the work are obtained in accordance with job requirements
2. Install equipment and accessories	2.1 ***Equipment*** and components are prepared for correct sequential installation 2.2 ***OSH policies*** **and** ***procedures*** for installation are followed according to manufacturer's specifications 2.3 ***PPE*** is used according to company requirements 2.4 Electrical cabling and wiring devices of correct loading capacity are selected and safely installed according to National Electrical Code 2.5 Equipment is installed in accordance with manufacturer's instructions, requirements, and without damage to self and others or surrounding place or environment 2.6 ***Unplanned events*** or conditions are responded to in accordance with established institutional procedures
3. Test installed equipment and accessories	3.1 Equipment is tested in accordance with manufacturer's instructions 3.2 Final inspections are undertaken to ensure that the installed device conforms with manufacturer's instructions. 3.3 ***Work site*** is cleaned and cleared of all debris and left safe in accordance with the institution's requirements. 3.4 Report on installation and testing of equipment is prepared and submitted according to institution's procedures. 3.5 Endorse equipment to appropriate end user according to institution's requirements

Variable	Range
Tools	Includes but is not limited to: • cutting, shaping, drilling, threading, tapping, finishing, dismantling/assembling tools • pliers (assorted) • screwdrivers (assorted) • soldering gun/iron • electric drill and assorted bits • Wrench and spanners (spanners) • Staple gun
Test devices	Include but are not limited to: • Multi-meter • Signal generator • Oscilloscope • Calibrators • Gauges (assorted) • Radiation detectors
Materials	Include but are not limited to: • Tape (assorted) • Sealing materials • Cables • Wires • Soldering Lead • Wire tie
Equipment	Include but are not limited to: • X-ray • CT scan • MRI • Radiotherapy machine • Lithotripter • Dialysis machine • Ultrasound • FACS (CD4 Counte • Hematology analyzer
Personal protection equipment	• Industrial Mask • Safety goggles • Coveralls • Gloves • Shoe cover
OSH policies and procedures	• Ethiopia Electrical Code • OSH guidelines • Environmental protection legislation and regulations
Unplanned events or conditions	Include but are not limited to: • Fire and Flood • Earthquake • Alert levels • Electrical shock • Power interruption • Power overload
Worksite	Include but not limited to: • Laboratory • Clinics • Operating room/Delivery room • Wards/Units/Emergency room

Evidence Guide	
Critical aspects of competence	Assessment requires evidence that the candidate: • Interpreted work instructions according to job requirements. • Appropriately selected electrical cabling and wiring devices used • Installed equipment in accordance with manufacturer's instructions. • Tested installed equipment according to manufacturer's instructions
Underpinning knowledge and attitudes	• Occupational safety and health guidelines • Specifications and proper use of tools • General concepts and principles in radiation technology • General concepts and principles in electronics and electricity ➢ AC/DC power supplies ➢ Operational amplifiers ➢ Digital electronics ➢ Wiring techniques • Use of test equipment and/ or instruments • Clinical application of equipment/instruments/tools • Drawing interpretation • Electronic hand soldering • Knowledge in computer
Underpinning skills	• interpret work instructions, diagrams, schematics • interpret, define and explain work procedures • Problem solving in emergency situation(s) • Troubleshooting • Courtesy and helping attitude • Use of computer
Resources Implication	Access to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace and OHS practices.
Resources Implication	• access to relevant workplace or appropriately simulated environment where assessment can take place • materials relevant to the proposed activity or task
Assessment Methods	Competence may be assessed through: • Interview / Oral questioning / 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Plan and Organize Work**
Unit Code	**EEL BES4 02 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	• Personnel • Equipment and technology • Services	• Supplies and materials • Sources for accessing specialist advice • Budget
Schedule of work activities	• Daily • Work-based • Contractual • Regular	• Confidential • Disclosure • Non-disclosure
Work methods and practices	• Work methods and practices may include but not limited to: • Legislated regulations and codes of practice • Industry regulations and codes of practice • Occupational health and safety practices	
Work plans	• Daily work plans • Maintenance plans • Program plans • Organization strategic and restructuring plans • Resource plans • Skills development plans • Management strategies and objectives	
Standards	• 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	• Appropriate personnel include: • Technicians • Line Staff
Feedback mechanisms	Feedback mechanisms include: • 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	• 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	• Leading • Planning, Organizing and Coordinating • Communication Skills • Inter-and intra-person/motivation skills • Presentation skills
Resource Implications	The following resources must be provided: • 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

TOP

Occupational Standard: : Biomedical Equipment Servicing Management Level IV	
Unit Title	**Manage biomedical equipment**
Unit Code	**EEL BES4 03 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to manage servicing operations for biomedical equipment.

Elements	Performance Criteria
1. Plan and prepare management of servicing operations	1.1 Management of servicing and maintenance of ***OHS policies and procedures*** is planned and prepared to ensure that the work sequence is in accordance with ***requirements***
	1.2 ***Appropriate personnel*** are consulted and directed to ensure the programs for servicing and maintenance are coordinated effectively with others involved on the work site
	1.3 Programs to be managed for servicing and maintenance are checked against job requirements
	1.4 Materials necessary to complete the work are identified and detailed in accordance with established procedures and checked against job requirements
	1.5 Tools, equipment and testing devices needed to carry out the work are identified and detailed in accordance with established procedures
	1.6 Procurement management plan is formulated for servicing and maintenance in accordance with established procedures and checked against requirements

1. Keep inventory of biomedical equipment	1.1 Inventory system is established based on Ethiopian asset management system. 1.2 Labels/tags are used in accordance with approved inventory formats and coding system 1.3 Equipment inventory is regularly conducted in accordance with institute policy and guidelines 1.4 Inventory records and reports are properly completed and submitted to appropriate personnel 1.5 Manuals are categorized and filed in an accessible manner 1.6 Data base system is established.
2 Manage and monitor servicing operation	2.1 Normal function of ***biomedical equipment*** and associated circuits are ascertained and detailed in accordance with requirements 2.2 Mechanisms are used to measure, record and report progress of activities in relation to the agreed servicing and maintenance schedules and plans 2.3 Servicing and maintenance system is managed and monitored in accordance with ***established procedures and requirements*** to achieve designated objectives 2.4 Response to ***unplanned events or conditions*** in accordance with established procedures are detailed 2.5 Records and documentation of servicing and maintenance activities are maintained in accordance with established procedures to facilitate quality management and to provide an audit trail. 2.6 Results of routine maintenance activities are monitored in accordance with established procedures to determine compliance with agreed quality standards 2.7 Shortfalls in quality outcomes are acted upon in accordance with established procedures to enable appropriate action to be initiated
3 Evaluate and document servicing system	3.1 Quality management issues and responses are reported in accordance with established procedures 3.2 Completion of servicing and maintenance is reported in accordance with established procedures
4. Improve work process and staff	4.1 Maintenance policy and procedures are documented and discussed with concerned personnel 4.2 Staff performance are evaluated 4.3 Staff upgrading schemes are planned and implemented to improve performance 4.4 Team spirit and favourable working environment is established 4.5 Critical issues are identified and addressed in accordance

	with company policy and guidelines 4.6 Work improvement and processes are recommended for decision makers' approval 4.7 Necessary documentation and reporting are accomplished and submitted based on company standard procedures

Variable	Range
OHS policies and procedures	Arrangements of an organization or enterprise to meet the legal and ethical obligations of ensuring that the workplace is safe and without risk to health. This may include: • hazardous and risk assessment mechanisms • safety training • implementation of safety regulations • safety systems incorporating - ▪ work clearance procedures ▪ isolation procedures ▪ gas and vapor ▪ monitoring/testing procedures ▪ use of protective equipment and clothing ▪ Radiation protection • Use of codes of practice
Requirements	Requirements may include: • codes of practice • job specifications • transport documentation • standards called-up in specifications • procedures and work instructions • quality assurance systems • manufacturers' specifications • maintenance manuals, schedules and specifications/standards • circuit/cable schedules • design specifications • customer/client requirements and specifications • specified underpinning knowledge (specified in units' evidence guides) • statutory regulations • national and regional guidelines , policies and directives relating to the environment
Appropriate person	May include but not limited to: • Managers • Engineers • Line managers • Technicians • Regulatory personnel

	• Other personnel designated by an organization or enterprise
Biomedical equipment	May include but not limited to • Imaging equipment • diagnostic equipment • therapeutic equipment • Laboratory equipment
Established procedures	Formal arrangements of an organization, enterprise or statutory authority of how work is to be done. These may include • Quality assurance systems incorporating, for example: ▪ Continues quality improvement procedures ▪ Work orders / instructions ▪ Reporting procedures ▪ Procurement procedures ▪ Accounting procedures ▪ Human resources development procedures • Work clearance systems incorporating, for example: ▪ Work permits ▪ Monitoring and clearance procedures ▪ Isolation procedures • OHS practices • Procedures for operating safety systems, operating plant and equipment and reporting work activities • Maintenance, modification or supply of relevant schematic drawings and technical data • Arrangements for dealing with emergency situations.
Unplanned events or conditions	May include but not limited to: • Accidents/incidents • Brownout • Equipment breakdown • Force majored e.g., earthquake, fire, typhoon

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Planned and prepared management of servicing and maintenance in accordance with OH&S policies and procedures • Checked programs to be developed for servicing and maintenance according to job requirements • Identified and detailed tools, equipment and materials

	needed to carry out work as specified in the user's manual and established procedures • Used mechanisms to measure, record and report progress of activities in relation to the agreed servicing and maintenance schedules and plans • Maintained records and documentation of servicing and maintenance activities • Reported quality management issues and responses in accordance with established procedures
Underpinning Knowledge and Attitudes	• Basic Electrical/Electronics • Computer operations • Flow charting • Business plan development ▪ Marketing plan ▪ Production plan ▪ Organization and management plan ▪ Financial plan • Laws, and regulation, Electrical and electronic code • Quality improvement ▪ Continuous process Improvement Philosophies and principals ▪ Product/Service Development ▪ Manufacturing Product/providing services ▪ Inspection of raw materials and outgoing product • Management ▪ HR Recourses management ▪ Fiscal management ▪ ISO 9000 ▪ Procurement management ▪ Records management ▪ Property management
Underpinning Skills	• Formulating Continuous Improvement policies and guidelines • Benchmarking • Preparing process capability control chart • Skills in operation of Basic computer system application • Drawing system and process flow chart
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials, diagrams and manuals, tools, test instruments and equipment, and to information on workplace practices and OHS practices.
Assessment Methods	Competence may be assessed through: • Interview / oral questioning / written exam • Simulation/demonstration • Observation
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Perform Technical Consultation**
Unit Code	**EEL BES4 04 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.

Elements	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 OHS*** and risk control measures and procedures in preparation for the work are followed.
	3.2 ***Policies and procedures*** are developed to include OHS 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	• managers • supervisors • technicians • other employees • OHS 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	• 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 OHS	• May 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	• Pro-active maintenance procedures • Re-active maintenance procedure • Operation and servicing procedures • Health and safety procedures

Schedule of work activities	• 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 • Testing and commissioning of equipment
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Biomedical devices and electrical equipment installation • maintaining and servicing Machines and Drives • Fundamentals of troubleshooting and repair of **Biomedical devices** • Code of practice in **Biomedical devices** 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	Demonstrates skills to: • Trouble shoot and repair Biomedical equipment • Interpersonal skills to develop rapport with other parties • Communication skills (verbal and listening) • Observation skills • Negotiation skills
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.
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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Maintain and repair Biomedical equipment**
Unit Code	**EEL BES4 05 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes necessary in conducting maintenance and repair of Biomedical Equipment.

Elements	Performance Criteria
1 Prepares maintenance protocol and Respond to client/customer service request	1.1 Covered ***biomedical equipment and accessories*** are identified 1.2 Appropriate ***request*** form is received in accordance with institution protocols 1.3 Update Biomedical Equipment / ABE /inventory on the covered ABE is secured and used as reference for preventive maintenance preparation 1.4 Repair history and equipment consumables are verified in line with the institution's procedure 1.5 Appropriate checklist forms tools, test equipment, calibrating tools, fast moving consumables and personal protective equipment are secured in line with job requirements 1.6 Prompt service is conducted on-site or in the workshop
2 Implements preliminary preventive maintenance protocol	2.1 Preventive maintenance program is properly communicated with the ***appropriate staff*** 2.2 Immediate surroundings of covered ABE are secured from ***unnecessary hazards*** 2.3 Performed basic biomedical equipment ocular inspection in accordance with institution's procedure 2.4 Cleaned and sanitized ABE in accordance with manufacturer standard and/or institution's procedure
3 Prepare the unit/equipment	3.1 Complete assembly check-up and fault symptoms are conducted, identified, and verified against client description and properly documented 3.2 Repair history is verified in line with the institution procedures 3.3 ***Service manuals and service information*** required for the corrective maintenance are made available at the beginning of the corrective maintenance activities 3.4 Workplace is cleaned in accordance with the institution procedure

4	Perform electrical safety testing	4.1 Set-up appropriate test equipment and Systematic pre-testing procedure in accordance with equipment manufacturer standards and established occupational health and safety practices 4.2 Line voltage, ground resistance and current leakage of the covered ABE are measured in accordance with manufacturer standards and in strict observance of the established occupational health and safety practices 4.3 Electrical safety test results with equipment manufacturer's safety standards are analyzed 4.4 Electrical faults are corrected in accordance with equipment manufacture standards
5	Diagnose faults	5.1 System detect is identified using appropriate tools and test equipment and in accordance with organizational policies and procedures 5.2 Accurate diagnosis is completed within the specified timeframe 5.3 Diagnosis and findings of Biomedical Equipment failures or technical problems are completely and accurately documented in accordance with institution standard. 5.4 Fault/s, defects and range of the problems are properly and courteously explained to the client in accordance with institution policy
6	Repair Biomedical Equipment and Perform functional test	6.1 Safety equipment is used to protect self and others in accordance with Established Occupational Health and Safety Practices 6.2 Defective spare parts/components are replaced with equivalent and/or better performing spare parts/components 6.3 Repair and/or replaced parts/components are soldered in accordance to current best industry practice 6.4 Necessary circuit adjustment, re-calibration and testing procedure is done and in conformance with equipment manufacturer specification standards 6.5 Necessary modification, conversion of parts and/or circuits is applied in accordance with industry best practice and equipment manufacturer specifications 6.6 Spare parts substitution is in accordance with the manufacturer's specification or equivalent 6.7 Corrective maintenance activity is accomplished within the required time frame 6.8 Care and extreme precaution in handling the unit is observed 6.9 Equipment set-up and start-up operation is performed in accordance with equipment manufacturer specifications 6.10 Equipment controls are set in accordance with manufacture's functional test standard 6.11 Controls and start up signals are checked in accordance with

	manufacturer standard operating procedure and safety regulations 6.12 ABE operation protocols are simulated in accordance with manufacturer standard 6.13 Equipment lubrication is done in accordance with manufacturer standards 6.14 Accessories of the covered ABE are inspected and set-up in accordance with institution and equipment manufacturer specification respectively 6.15 Appropriate equipment consumables are replaced in accordance with manufacturer specifications 6.16 Functional test is completed within the specified time as provided in the institution ABE preventive maintenance procedures and guidelines

7 Check and calibrate Biomedical Equipment (ABE)	7.1 Appropriate calibration procedures and parameters are determined in accordance with equipment manufacturer standards and/or institution's guidelines 7.2 Calibration equipment is set-up in accordance with manufacturer standard and occupational and health safety procedures 7.3 ABE operation is simulated in accordance with equipment manufacturer standards 7.4 Calibration controls are crossed check and verified in accordance with manufacturer specifications 7.5 Necessary adjustments are made in accordance with equipment manufacturer instruction. 7.6 Covered ABE is subjected to final test in accordance with institution guidelines and procedures. 7.7 Performance and functional test is conducted immediately after re-assembly 7.8 Equipment status and performance is checked and ensured conformance with equipment manufacturer standard and other health safety regulations 7.9 Complete and accurate documentation is prepared. 7.10 Tools and test instrument are cleaned and cared as per organizational procedure 7.11 Waste materials are disposed in accordance with hospital waste management and other environmental requirements

8 Re-commission ABE	8.1 Reassembled ABE are subjected to final testing in accordance with institution standard 8.2 ABE and its immediate surrounding are cleaned in accordance with institution policy 8.3 Communicated with appropriate staff that preventive maintenance procedure is done and brief's the same on equipment status as per institution standard 8.4 Biomedical equipment and its immediate surrounding are cleaned in accordance with institution policy 8.5 Appropriate staff is communicated on the status of the equipment as per institution standards
9 Document preventive and corrective maintenance activities	9.1 Biomedical equipment checklist forms and other preventive and corrective maintenance documents are accomplished in strict observance of institution standards 9.2 Reports are submitted to proper officer/office in accordance with institution policy 9.3 Preventive maintenance documents are systematically kept and updated as per institution standards 9.4 Health care equipment corrective maintenance form and other relevant reports are accomplished in strict observance of institution standards 9.5 Reports are submitted to proper officer/offices in accordance with institution policy 9.6 Corrective Maintenance documents are systematically kept and updated as per institution standards
Variable	**Range**
request	*Proper service request form* • Formal service request letter • Verbal service request (actual or phone) • Electronic communication equipment
Biomedical equipment	Include but are not limited to: • X-ray • CT scan • MRI • Radiotherapy machine • Lithotripter • Dialysis machine • Ultrasound • FACS (CD4 Counter) • Hematology analyzer

Checklist form	Covered equipment P.M. checklist form
Tools, test equipment and calibrating tool	Includes but not limited to: • Screwdrivers (assorted) • Soldering iron/gun • De-soldering tool • Wrenches (assorted) • Pliers (assorted) • Dosimeter • Radiation Detector • Cleaning Brush • Thermometer (digital & mercurial) • Electrical Safety Analyzer • Multi meter (analog/digital) • Utility knife • Alignment tool • Gas leakage tester
Service manuals and information	• Operation's Manuals • Service/Technical Manual • Installation Manual • Parts List Manual • Job Report Sheets • Job Request/Order • Equipment History Card • Supplier Index
Fast moving consumables	Includes but not limited to: • Oil, cleaning agents • Fuses (assorted) • Contact cleaner • Soldering lead • Tape (assorted) • Filters (assorted) • Sealing materials • Screws (assorted) • Wire tie • X-Ray Films •
Appropriate staff	• End-user • Immediate supervisor • Managers • Technicians
Personal Protective Equipment	• Working clothes • Hand Gloves • Goggles • Mask • Shoe cover • Lead Apron
Hazards	• People • Wet floors • Open electrical wiring • Location • Unsafe Ionized and non Ionized Radiation

Evidence Guide	
Critical aspects of Competence	Assessment requires evidence that the candidate: • Interpreted work instructions according to job

	requirements. • Appropriately selected electrical cabling and wiring devices used. • Installed equipment in accordance with manufacturer's instructions. • Tested installed equipment according to manufacturer's instructions
Underpinning knowledge and attitudes	• Occupational safety and health guidelines • Specification and proper use of tools • General concepts and principles of in electronics and electricity ➢ AC/DC power supplies ➢ Operational amplifiers ➢ Digital electronics ➢ Wiring techniques ➢ Power Electronics ➢ Micro-processor ➢ Basic Computer software programming • Use of test equipment/instruments • Clinical application of equipment/instruments/tools • Drawing interpretation • Electronic hand soldering
Underpinning skills	• Reading skills required to interpret work instructions, diagrams, schematics • Communication skills needed to interpret and define and explain work procedures • Problem solving in emergency situation • Soldering • Troubleshooting • Maintenance • Software programming • Courtesy and helping attitude
Resources Implication	Access to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace and OHS practices.
Assessment Methods	Competence may be assessed through: • Interview / Oral Questioning / 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Train Biomedical Equipment Users**
Unit Code	**EEL BES4 06 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required in training end-users and operators in the use of biomedical equipment.

Elements	Performance Criteria
1. Plan the training	1.1 Biomedical equipment types are identified and categorized 1.2 End-users / operators of equipment are identified in and categorized 1.3 Training plan is developed considering types of equipment, number and qualification of operators/end-users 1.4 Training plan is integrated with plan of other activities 1.5 Training plan proposal submitted to the management following institutional procedures and formats
2. Assess training needs	2.1 Assessment of methodology is determined based on number, distribution and accessibility of target group 2.2 Assessment tools are developed based on the characteristics of the target group 2.3 Data are collected that are representative to the target group 2.4 Data are analyzed and training needs are identified for the target group
3. Prepare training materials	3.1 Course outline is developed based on the need assessment 3.2 Time schedule is prepared based on the course outline and available time for training 3.3 Types of training materials are determined based on course content and training schedule. 3.4 ***Training materials*** are prepared based on the training content and available time
4. Conduct training	4.1 Introduction is made between trainers and trainees based on the introduction format 4.2 Objective of the training is introduced to trainees based on the course design 4.3 Training is conducted in accordance with agreed schedule 4.4 Appropriate training methods and approach are utilized during training 4.5 Trainees are assessed using appropriate assessment methods and procedures 4.6 Training is evaluated by the trainer and trainees

5. Evaluate training outcomes	5.1 Evaluation methodology is determined considering the objectives of the training given 5.2 Evaluation tools are developed based on the characteristics of the target group 5.3 Data are collected from the target group 5.4 Data are analyzed applying appropriate methods and procedures 5.5 Analysis output is interpreted based on the objectives of the training 5.5 Evaluation report is prepared and recorded in accordance to standard report format

Variable	**Range**
Training materials	May include but not limited to: • manufacturer's manuals • company procedures • training handouts • maintenance manual • reference book

Evidence Guide	
Critical aspects of competence	Assessment requires evidence that the candidate: • planned training • assessed training needs • prepared training materials • conducted training • evaluated outcome of training
Underpinning Knowledge and Attitudes	Demonstrate knowledge of : • learning methods and approach • training material development • computer application • safety rules and regulations • equipment operation and principles • training need assessment • assessment procedures and techniques • training evaluation
Underpinning Skills	Demonstrate skills in: • planning the training • assessing training needs • preparing training materials • conducting training • evaluating training outcomes • using computer

	• using visual aids and equipment
Resources Implication	Access to real or appropriately simulated situations, including work areas, materials, and equipment
Assessment Methods	Competence may be assessed through: • Interview / oral questioning / written exam • Observation /demonstration
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Apply Problem Solving Techniques**
Unit Code	**EEL EES4 07 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.

Element	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: • Identified the problem • Determined the fundamental causes of the problem • Determined the correct / preventive action • Provided recommendation to manager.
Underpinning Knowledge	Competence includes a thorough knowledge and • understanding of the process, normal operating • parameters, and product quality to recognize non- • standard situations • sufficient for the identification of fundamental cause, • determining the corrective action and provision of • recommendations • Relevant equipment and operational processes • Enterprise goals, targets and measures • Enterprise quality, OHS and environmental requirement • Principles of decision making strategies and techniques • Enterprise information systems and data collation • Industry codes and standards

Underpinning Skills	• Using range of formal problem solving techniques • Identifying and clarifying the nature of the problem • Devising the best solution • Evaluating the solution • Implementation of a developed plan to rectify the problem
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials, diagrams and manuals, tools, test instruments and equipment, and to information on workplace practices and OHS practices.
Assessment Methods	Competence may be assessed through: • Interview / oral questioning / written exam • Simulation/demonstration • Observation
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Biomedical Equipment Servicing Management Level IV	
Unit of Competence Title	**Find and repair faults in measuring and analysis systems**
Unit Code	**EEL BES4 08 0511**
Unit Descriptor	This unit covers finding and repairing faults in measuring, analysis and control systems in biomedical equipment.. 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 OHS procedures for a given work area are identified, obtained and understood 1.2 OHS 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 OHS 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 OHS requirements and when necessary conducted within established safety procedures. 2.3 Apparatus is checked as being isolated where necessary in strict accordance OHS 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 OHS 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	**Statements**
Unit scope	This unit must be demonstrated in relation to finding and repairing at least four faults in two different types of measuring and analytical equipment. 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)	Apply OH&S requirements in accordance with regulations/codes of practice and enterprise safety policies and procedures. This may include: - Using of relevant protective clothing and equipment, - use of tooling and equipment, - workplace environment and safety handling of material, - use of fire fighting equipment, enterprise first aid, - hazard control and hazardous materials and substances. - Using Chemical prove gowns, rubber boots of appropriate size, Goggles, respirators, helmet, and head phones , gloves etc, - Following Occupational health and safety procedures designated for the task - Checking and fulfilling required safety devices before starting operation Apply safe operating procedures regarding: - electrical safety, - machinery movement and operation, - manual and mechanical lifting and shifting, - working in proximity to others and site visitors. Apply emergency procedures :

	- emergency shutdown and sping of equipment, - 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
Types and Sources of Information	Information source may include variable written and graphical instructions, work bulletins, data sheet, diagrams or sketches - 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
Required knowledge	The extent of the essential knowledge and associated skills (EKAS) required is given . It forms an integral part of this unit. A. Measurement circuits and applications B. Gas analysis C. Water analysis D. Scientific analysis E. Weight measurement principles F. Occupational Health and Safety principles G. Instrumentation safe working practices

Evidence guide	**Descriptions**
Critical Aspects of Competence	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 below: Find and repair faults in measuring and analysis systems as described in 8) and including: A. Using methodical fault finding techniques B. Finding faults efficiently C. Replacing components without damage D. Providing written justification for the repairs E. 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
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 - 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Configure and Calibrate Biomedical Equipment**
Unit Code	**EEL BES4 09 0511**
Unit Descriptor	This unit covers the knowledge, skills and attitudes needed to configure and **Calibrate Biomedical Equipment**

Elements	Performance Criteria
1. Plan and prepare for configuration	1.1 ***OHS 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 **Biomedical Equipment** are conditioned according to plan or standards in line with the job requirements 1.5 **Biomedical Equipment** 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 **Biomedical Equipment**	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 **Biomedical Equipment** 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 Biomedical Equipment	2.1 Appropriate personal protective equipment is used based on OHS policies and procedures. 2.2 Normal functions of devices are checked in accordance with manufacturer's instructions & standard procedures. 2.3 **Biomedical Equipment** to be calibrated are conditioned according to plan or standards

	2.4 Fault/s or problem/s in the device is/are diagnosed in line with the standard operating procedures. 2.5 **Biomedical Equipment** are calibrated and / or adjusted in line with the standard operating procedures. 2.6 Unplanned events or conditions are responded to in accordance with established procedures
4. Inspect and test configured and calibrated **Biomedical Equipment**	3.1 Configured and calibrated devices are initially inspected for accurateness before final functional tests are conducted 3.2 Final inspections are undertaken to ensure that the configuration and calibration done on the devices conforms with the manufacturer's instruction/ manual 3.3 **Biomedical Equipment** are checked to ensure safe operation 3.4 Report is prepared/ completed according to company requirements.

Variable	**Range**
OH & S policies and procedures	• OH & S guidelines • Ethiopian environmental proclamations and regulations
Biomedical Equipment 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)
Biomedical Equipment /systems	Include but not limited to: • Sensor 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	Include but not limited to:

Knowledge	• 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	• 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: • 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Establish Quality systems and procedures**
Unit Code	**EEL BES4 10 0511**
Unit Descriptor	This unit covers the knowledge, attitudes and skills required to establish quality systems and procedures of Biomedical Equipment Servicing Management and maintenance work. It includes participating in maintaining and improving quality at work, 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 and outputs	1.1 Biomedical Equipment Servicing Managementand maintenance quality standard and requirements are identified. 1.2 Quality specifications developed and agreed upon 1.3 ***Occupational Health and Safety requirements*** are obtained from the site safety plan and organizational policies and procedures, confirmed and applied to the allotted task 1.4 Quality specifications are documented and introduced to organization staff / personnel in accordance with the organization policy 1.5 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, 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.

Variable	**Range**
Occupational Health and Safety requirements	May include but not limited to: • workplace environment and handling of material safety • following occupational health and safety procedures designated for Biomedical Equipment Servicing Managementand maintenance work • use of tools and equipment for biomedical equipment maintenance. • 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 biomedical equipments.

Evidence Guide	
Critical Aspect of Competence	Demonstrate skills and knowledge in: • Monitoring quality of work • Establishing quality procedure for the biomedical equipment maintenance. • Participating in maintaining and improving quality at work • Identifying hazards and critical control points in Biomedical Equipment Servicing Managementand maintenance work quality. • Assisting in planning of quality assurance procedures • Reporting problems that affect quality • Implementing quality assurance procedures
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • Basic mathematical techniques associated with supervision • Biomedical Equipment Servicing Managementand maintenance quality assurance methods. • Accessing and using management systems to keep and maintain accurate records
Underpinning Skills	Demonstrates skills in: • Monitoring quality of work • Participating in maintaining and improving quality of the work • Identifying hazards and critical control points in the Biomedical Equipment Servicing Managementand maintenance of the biomedical equipment.. • 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 exam / oral questioning • observation/demonstration
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting

TOP

Occupational Standard: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Develop Individuals and Teams**
Unit Code	**EEL BES4 11 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Utilize Specialized Communication Skills**
Unit Code	**EEL BES4 12 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Manage and Maintain Small/Medium Business Operation**
Unit Code	**EEL BES4 13 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Migrate to New Technology**
Unit Code	**EEL BES4 14 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: Biomedical Equipment Servicing Management Level IV	
Unit Title	**Manage Continuous Improvement System**
Unit Code	**EEL BES4 15 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

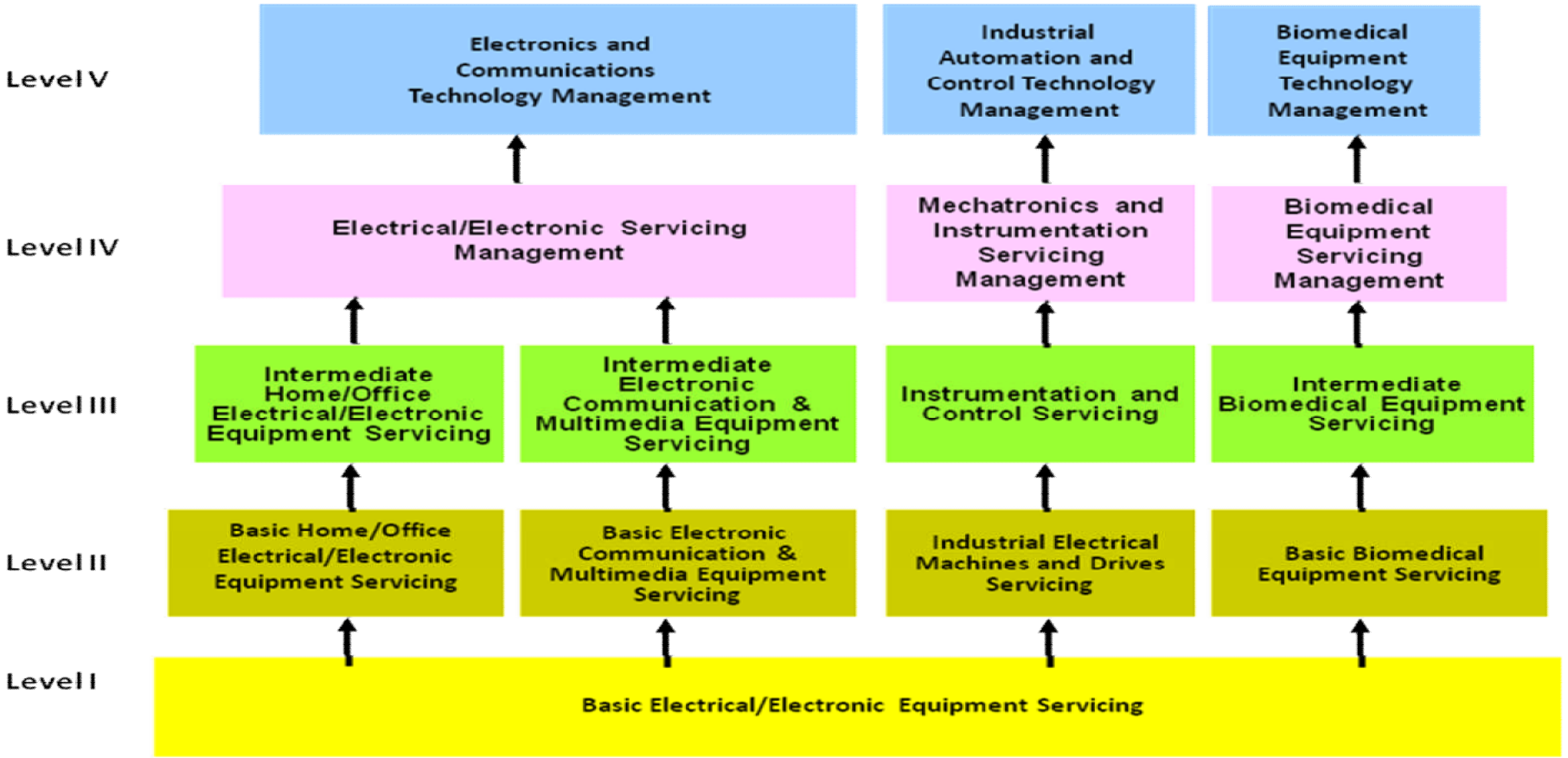
Variable	**Range**
Sustainability may include:	• addressing environmental and resource sustainability initiatives, such as environmental management systems, action plans, green office programs, surveys and audits • applying the waste management hierarchy in the workplace • complying with regulations 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



Acknowledgement

We wish to extent thanks and appreciation to the many representatives of business, industry, academe and government agencies who donated their time and expertise to the development of this occupational standard.

We would like also to express our appreciation to the Experts of Minister of Education (MoE) and Engineering Capacity Building program (ECBP) who made the development of this occupational standard possible.

This occupational standard was developed on May 2011 at Addis Ababa, Ethiopia.