TRAINING REGULATIONS

MECHATRONICS SERVICING NC IV

ELECTRICAL & ELECTRONICS SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Luzon Expressway, Taguig City, Metro Manila

Technical Education and Skills Development Act of 1994
(Republic Act No. 7796)

Section 22, "Establishment and Administration of the National Trade Skills Standards" of the RA 7796 known as the TESDA Act mandates TESDA to establish national occupational skills standards. The Authority shall develop and implement a certification and accreditation program in which private industry group and trade associations are accredited to conduct approved trade tests, and the local government units to promote such trade testing activities in their respective areas in accordance with the guidelines to be set by the Authority.

The Training Regulations (TR) serve as basis for the:

1 Competency assessment and certification;
2 Registration and delivery of training programs; and
3 Development of curriculum and assessment instruments.

Each TR has four sections:

Section 1 **Definition of Qualification** – describes the qualification and defines the competencies that comprise the qualification.

Section 2 The **Competency Standards** format was revised to include the Required Knowledge and Required Skills per element. These fields explicitly state the required knowledge and skills for competent performance of a unit of competency in an informed and effective manner. These also emphasize the application of knowledge and skills to situations where understanding is converted into a workplace outcome.

Section 3 **Training Arrangements** - contain information and requirements which serve as bases for training providers in designing and delivering competency-based curriculum for the qualification. The revisions to section 3 entail identifying the Learning Activities leading to achievement of the identified Learning Outcome per unit of competency.

Section 4 **Assessment and Certification Arrangements** - describe the policies governing assessment and certification procedures for the qualification.

TABLE OF CONTENTS

ELECTRICAL & ELECTRONICS SECTOR

MECHATRONICS SERVICING
NATIONAL CERTIFICATE LEVEL IV

TRAINING REGULATIONS FOR MECHATRONICS SERVICING NC IV

SECTION 1: MECHATRONICS SERVICING NC IV QUALIFICATIONS

The MECHATRONICS SERVICING NC IV Qualification consists of competencies that must be possess to enable a person to develop advanced PLC and HMI software programs and perform commissioning, diagnostics & troubleshooting on advanced PLC- and HMI-based mechatronics and automation systems.

This Qualification is packaged from the competency map of the Electrical & Electronics Industry Sector as shown in Annex A.

The units of competency comprising this qualification include the following:

Code	BASIC COMPETENCIES
500311115	Utilize specialized communication skills
500311116	Develop teams and individuals
500311117	Apply problem solving techniques in the workplace
500311118	Collect, analyze and organize information
500311119	Plan and organize work
500311120	Promote environmental protection

Code	COMMON COMPETENCIES
ELC311205	Use Hand Tools
ELC311201	Perform Mensuration and Calculation
ELC311202	Prepare and Interpret Technical Drawing
ELC311204	Apply Quality Standards
ELC311203	Perform Computer Operations
ELC311206	Terminate and Connect Electrical Wiring and Electronic Circuits
ELC311209	Test Electronic Components

Code	CORE COMPETENCIES
ELC311306	Develop advanced PLC and HMI application program
ELC311307	Commission advanced PLC- and HMI-based mechatronics and automation systems
ELC311308	Diagnose and troubleshoot advanced PLC- and HMI-based mechatronics and automation systems

A person who has achieved this Qualification is competent to be an:

- Mechatronics Technician
- Industrial Automation Technician

SECTION 2: COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common, and core units of competency required for Mechatronics Servicing NC IV.

BASIC COMPETENCIES

UNIT OF COMPETENCY: UTILIZE SPECIALIZED COMMUNICATION SKILLS

UNIT CODE : 500311115

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to use specialized communication skills to meet specific needs of internal and internal clients, conduct interviews, facilitate group of discussions, and contribute to the development of communication strategies.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• Communication process • Dynamics of groups and different styles of group leadership • Communication skills relevant to client groups	• Full range of communication techniques including: o Full range of communication o Active listening o Feedback o Interpretation o Role boundaries setting o Negotiation o Establishing empathy • Communication skills required to fulfill job roles as specified by 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	• Different communication strategies • Strategies in negotiations and conflict resolution	• Full range of communication techniques including: o Active listening o Feedback o Interpretation o Role boundaries setting o Negotiation o Establishing empathy • Communication skills required to fulfill job roles as specified by the organization

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	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	• Communication process • Communication skills relevant to client groups • Appropriate presentation tools and materials	• Computer skills • Communication skills required to fulfill job roles as specified by the organization
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	• Communication process • Dynamics of groups and different styles of group leadership • Communication skills relevant to client groups	• Full range of communication techniques including: ○ Role boundaries setting ○ Negotiation ○ Establishing empathy • Communication skills required to fulfill job roles as specified by the organization
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	• Communication process • Effective questioning, listening and nonverbal communication techniques	• Full range of communication techniques including: ○ Active listening ○ Feedback ○ Negotiation ○ Establishing empathy

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	5.3 Effective questioning, listening and nonverbal communication techniques are used to ensure that required message is communicated	• Communication skills relevant to client groups • Types of Interview	• Communication skills required to fulfill job roles as specified by the organization

RANGE OF VARIABLES

VARIABLES	RANGE
1. Strategies	1.1 Recognizing own limitations 1.2 Referral to specialists 1.3 Utilizing techniques and aids 1.4 Providing written drafts 1.5 Verbal and non verbal communication
2. Effective group interaction	2.1 Identifying and evaluating what is occurring within an interaction in a non-judgmental way 2.2 Using active listening 2.3 Making decision about appropriate words, behavior 2.4 Putting together response which is culturally appropriate 2.5 Expressing an individual perspective 2.6 Expressing own philosophy, ideology and background and exploring impact with relevance to communication
3. Types of Interview	3.1 Related to staff issues 3.2 Routine 3.3 Confidential 3.4 Evidential 3.5 Non-disclosure 3.6 Disclosure
4. Interview situations	4.1 Establish rapport 4.2 Elicit facts and information 4.3 Facilitate resolution of issues 4.4 Develop action plans 4.5 Diffuse potentially difficult situation

EVIDENCE GUIDE

1. Critical aspects of Competency	**Assessment requires evidence that the candidate:** 1.1 Demonstrated effective communication skills with clients accessing service and work colleagues 1.2 Adopted relevant communication techniques and strategies to meet client particular needs and difficulties
1 Resource Implications	Access to appropriate workplace where assessment can take place
2 Methods of Assessment	**Competency in this unit may be assessed through:** 2.1 Direct observation 2.2 Oral Interview
3 Context for Assessment	This unit should be assessed on the job through simulation

UNIT OF COMPETENCY : DEVELOP TEAMS AND INDIVIDUALS

UNIT CODE : 500311116

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.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• Coaching and mentoring 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 for eliciting and interpreting feedback	• Ability to : o read and understand a variety of texts, o prepare general information and documents according to target audience; o spell with accuracy; o use grammar and punctuation effective relationships and conflict management • Communication skills • Coaching and mentoring skills to provide support to colleagues
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 competency 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	• Coaching and mentoring principles • Understanding how to work effectively with team members who have diverse work styles, aspirations, cultures and perspective • Understanding methods and techniques for eliciting and interpreting feedback	• Communication skills including receiving feedback and reporting, maintaining effective relationships and conflict management • 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

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	2.4. Resources and timelines required for learning activities are identified and approved in accordance with organizational requirements		• Facilitation skills to conduct small group training sessions
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 competency are maintained within organizational requirement	• Understanding how to facilitate team development and improvement • Understanding methods and techniques for eliciting and interpreting feedback • Understanding methods for identifying and prioritizing personal development opportunities and options • Knowledge of career paths and competency standards in the industry	• Communication skills including receiving feedback and reporting, maintaining effective relationships and conflict management • 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 • Ability to relate to people from a range of social, cultural, physical and mental backgrounds
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	• Understanding methods and techniques for eliciting and interpreting feedback • Understanding methods for identifying and prioritizing personal development opportunities and options • Knowledge of career paths and competency standards in the industry	• Communication skills including receiving feedback and reporting, maintaining effective relationships and conflict management • Coaching and mentoring skills to provide support to colleagues • Facilitation skills to conduct small group training sessions

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
			• Ability to relate to people from a range of social, cultural, physical and mental backgrounds
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	• Team activities and communication processes • 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 • Knowledge of career paths and competency standards in the industry	• 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 • Ability to relate to people from a range of social, cultural, physical and mental backgrounds

RANGE OF VARIABLES

VARIABLES	RANGE
1. Learning and development needs	1.1 Coaching, mentoring and/or supervision 1.2 Formal/informal learning program 1.3 Internal/external training provision 1.4 Work experience/exchange/opportunities 1.5 Personal study 1.6 Career planning/development 1.7 Performance appraisals 1.8 Workplace skills assessment 1.9 Recognition of prior learning
2. Organizational requirements	2.1 Quality assurance and/or procedures manuals 2.2 Goals, objectives, plans, systems and processes 2.3 Legal and organizational policy/guidelines and requirements 2.4 Safety policies, procedures and programs 2.5 Confidentiality and security requirements 2.6 Business and performance plans 2.7 Ethical standards 2.8 Quality and continuous improvement processes and standards
3. Feedback on performance	3.1 Formal/informal performance appraisals 3.2 Obtaining feedback from supervisors and colleagues 3.3 Obtaining feedback from clients 3.4 Personal and reflective behavior strategies 3.5 Routine and organizational methods for monitoring service delivery
4. Learning delivery methods	4.1 On the job coaching or mentoring 4.2 Problem solving 4.3 Presentation/demonstration 4.4 Formal course participation 4.5 Work experience 4.6 Involvement in professional networks 4.7 Conference and seminar attendance 4.8 Induction

EVIDENCE GUIDE

1. Critical aspects of Competency	**Assessment requires evidence that the candidate:** 1.1. Identified and implemented learning opportunities for others 1.2. Gave and received feedback constructively 1.3. Facilitated participation of individuals in the work of the team 1.4. Negotiated learning plans to improve the effectiveness of learning 1.5. Prepared learning plans to match skill needs 1.6. Accessed and designated learning opportunities
2. Resource Implications	**The following resources should be provided:** 2.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2. Materials relevant to the proposed activity or tasks
3. Methods of Assessment	**Competency in this unit may be assessed through:** 3.1. Observation of work activities of the individual member in relation to the work activities of the group 3.2. Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal 3.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
4. Context for Assessment	4.1. Competency may be assessed in workplace or in a simulated workplace setting 4.2. Assessment shall be observed while task are being undertaken whether individually or in-group

UNIT OF COMPETENCY : APPLY PROBLEM SOLVING TECHNIQUES IN THE WORKPLACE *(Critical thinking and problem solving techniques)*

UNIT CODE : 500311117

UNIT DESCRIPTOR : This competency covers the knowledge, skills and attitudes required to apply the process of problem solving and other problems beyond those associated directly with the process unit. It includes the application of structured processes and improvement tools. This competency is typically performed by an experienced technician, team leader or supervisor.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Analyze the problem *(Use system thinking)*	1.1. Issues/concerns are evaluated based on data gathered 1.2. Possible causes of problem are identified within the ***area of responsibility*** as based on experience and the use of problem solving tools/analytical techniques 1.3. Possible cause statements are developed based on findings	• Broad understanding of systems, organizational systems and functions • Broad knowledge of help desk and maintenance practices • Broad knowledge of the client business domain • Broad knowledge based of diagnostic tools • General principles of OHS • Divisional/unit responsibilities	• Decision making within a limited range of options. • Communication is clear, precise and varies according to the type of audience • Time management as applied to self-management. • 1Analytical skills in relation to routine malfunctions.
2. Identify possible solutions	2.1 All possible options are considered for resolution of the problem in accordance with ***safety*** and operating procedures 2.2 Strengths and weaknesses of possible options are considered 2.3 Corrective action is determined to resolve the problem and its possible future causes	• Broad understanding of systems, organizational systems and functions • Broad knowledge of help desk and maintenance practices • Current industry accepted hardware and software products with broad and detailed knowledge of its general features and capabilities • Broad knowledge of the operating system • Broad knowledge of the client business domain • Broad knowledge based of diagnostic tools	• Decision making within a limited range of options. • Communication is clear, precise and varies according to the type of audience • Teamwork in reference to personal responsibility • Time management as applied to self-management. • Analytical skills in relation to routine malfunctions. • General customer service skills displayed • Questioning and active listening is employed to clarify general information

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Recommend solution to higher management *(Make judgment and decisions/ Solve problems)*	3.1 Report/ ***communication*** or ***documentation*** are prepared 3.2 Recommendations are presented to appropriate personnel 3.3 Recommendations are followed-up, if required	• Broad understanding of systems, organizational systems and functions • Broad knowledge of help desk and maintenance practices • Broad knowledge of the operating system • Broad knowledge of the client business domain • Broad knowledge based incorporating current industry practices related to escalation procedures • Broad knowledge based of diagnostic tools	• Decision making within a limited range of options. • Communication is clear, precise and varies according to the type of audience • Teamwork in reference to personal responsibility • Time management as applied to self-management. • Analytical skills in relation to routine malfunctions. • General customer service skills displayed
4. Implement solution	4.1 Measurable objectives are identified 4.2 Resource needs are identified 4.3 Timelines are identified in accordance with plan	• Broad knowledge of help desk and maintenance practices • Broad knowledge of the client business domain • Broad knowledge based incorporating current industry practices related to escalation procedures • Broad knowledge based of diagnostic tools • General principles of OHS • Divisional/unit responsibilities	• Decision making within a limited range of options. • Time management as applied to self-management. • Analytical skills in relation to routine malfunctions. • General customer service skills displayed. • Questioning and active listening is employed to clarify general information
5. Evaluate/ Monitor results and outcome	5.1 Processes and improvements are identified based on evaluative assessment of problem 5.2 Recommendations are prepared and submitted to superiors.	• Broad knowledge of the client business domain • Broad knowledge based incorporating current industry practices related to escalation procedures • Broad knowledge based of diagnostic tools • General principles of OHS • Divisional/unit responsibilities	• Time management as applied to self-management. • Analytical skills in relation to routine malfunctions. • General customer service skills displayed. • Questioning and active listening is employed to clarify general information

RANGE OF VARIABLES

VARIABLES	RANGE
1. Area of responsibility	May include: 1.1. Work environment 1.2. Problem solution processes 1.3. Preventative maintenance and diagnostic policy 1.4. Roles and technical responsibilities
2. Occupational Health and Safety	2.1. As per company, statutory and vendor requirements. Ergonomic and environmental factors must be considered during the demonstration of this competency.
3. Communication	3.1. Variables may include but are not limited to: 3.2. Written communication can involve both hand written and printed material, internal memos, electronic mail, briefing notes and bulletin boards.
4. Documentation	4.1. Audit trails 4.2. Naming standards 4.3. Version control

EVIDENCE GUIDE

1. Critical aspects of Competency	**Assessment requires evidence that the candidate:** 1.1. Analyzed the problem 1.2. Identified possible solutions 1.3. Implemented solutions 1.4. Recommended solutions to higher management 1.5. Outcome evaluated/monitored Evidence of satisfactory performance in this unit can be obtained by observation of performance and questioning to indicate knowledge and understanding of the elements of the competency and performance criteria.
2. Resource Implications	Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios/case studies/what ifs will be required as well as bank of questions which will be used to probe the reasoning behind the observable actions.
3. Methods of Assessment	**Competency in this unit may be assessed through:** Through direct observation of application to tasks and questions related to underpinning knowledge Under general guidance, checking various stages of operation and at the completion of the activity against performance criteria and specifications
4. Context for Assessment	4.1. Competency may be assessed in the work place or in a simulated work place setting 4.2. Assessment shall be carried out through TESDA's Accredited Assessment Centers/Venues while tasks are undertaken either individually or as part of a team under limited supervision

UNIT OF COMPETENCY : COLLECT, ANALYZE AND ORGANIZE INFORMATION
***(Access and evaluate information*)**

UNIT CODE : 500311118

UNIT DESCRIPTOR : This unit covers the outcomes required to process, analyze, interpret and organize workplace information and other relevant data.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Study information requirements	1.1 Needs are identified using established ***research procedures*** 1.2 Relevant ***forms*** and recording systems are used to gather the information 1.3 Respondents are selected to implement survey / research based on established procedures	• Data processing, Information analysis and interpretation • Research methods o Qualitative o Quantitative o Statistical • Report writing • Use of relevant software o Spreadsheets o Presentation graphics o Work processor o Statistical package	• Communicating effectively • Performing research • Reading / interpreting data and information • Problem solving
2. Process data	2.1 ***Data*** are collected and collated based on the prescribed method. 2.2 Relevant data are used as references in accordance with the objectives of the program. 2.3 ***Information*** is compiled according to the required form	• Data processing, Information analysis and interpretation • Research methods o Qualitative o Quantitative o Statistical • Report writing	• Communicating effectively • Performing research • Reading / interpreting data and information • Problem solving
3. Analyze, interpret and organize information gathered	3.1 Data are analyzed using relevant ***methodologies*** 3.2 Where applicable, ***statistical analysis/methods*** are employed according to the objectives of the program 3.3 Graphs and other visual presentations are prepared to facilitate analysis / interpretation of information	• Data processing, Information analysis and interpretation • Research methods o Qualitative o Quantitative o Statistical • Report writing • Use of relevant software o Spreadsheets o Presentation graphics o Work processor o Statistical package	• Communicating effectively • Performing research • Reading / interpreting data and information • Problem solving

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS

4. Present findings/ recommendations	4.1 Findings/ recommendations summarized and presented/packaged in user-friendly manner
	4.2 Relevant inputs gathered to finalize report
	4.3 Draft report prepared based on standard format.
	4.4 Technical reports are submitted and disseminated to concerned offices.
		• Data processing, Information analysis and interpretation
		• Research methods
		  ○ Qualitative
		  ○ Quantitative
		  ○ Statistical
		• Report writing
		• Use of relevant software
		  ○ Spreadsheets
		  ○ Presentation graphics
		  ○ Work processor
		  ○ Statistical package
			• Communicating effectively
			• Performing research
			• Reading / interpreting data and information
			• Problem solving

RANGE OF VARIABLES

VARIABLES	R A N G E
1. Research procedures	May include: 1.1 TNA 1.2 Front-end analysis 1.3 Surveys 1.4 Interviews 1.5 Functional analysis 1.6 DACUM research
2. Forms	May include: 2.1 Survey forms/Questionnaires 2.2 Personal information/Profile 2.3 Accident report form 2.4 Requisition slip 2.5 Job orders 2.6 Purchase request form 2.7 Incident report form
3. Methodologies	May include: 3.1 Qualitative methods 3.2 Quantitative methods
4. Statistical analysis/ methods	May include: 4.1. Averages (Mean, Median, Mode) 4.2. Percentage 4.3. Ranks 4.4. Frequency Distribution 4.5 Statistical test
5. Data	May include: Raw Data
6. Information	May include: Processed and packaged data

EVIDENCE GUIDE

1. Critical Aspects of Competency	**Assessment requires evidence that the candidate:** 1.1 Determined information requirements based on organizational goals and objectives. 1.2 Used relevant forms and recording systems to gather data 1.3 Processed data based on the objectives of the program 1.4 Utilized relevant research methods based on the objective of the program 1.5 Analyzed and organized information gathered 1.6 Submitted/Disseminated technical reports to concerned offices
2. Resource Implications	**The following resources should be provided:** 2.1 Workplace or assessment location 2.2 Access to office equipment and facilities relevant to the unit 2.3 Case studies/scenarios
3. Methods of Assessment	Competency may be assessed through: 3.1 Written/ Oral Examination 3.2 Interviews 3.3 Portfolio
4. Context for Assessment	Competency may be assessed in actual workplace or TESDA Accredited Assessment Center

UNIT OF COMPETENCY : PLAN AND ORGANIZE WORK *(Manage projects)*

UNIT CODE : 500311119

UNIT DESCRIPTOR : This unit covers the outcomes required in planning and organizing work. It may be applied to a small independent operation or to a section of a large organization.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
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	• 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	• Planning • Leading • Organizing • Coordinating • Communication Skills • Inter-and intra-person/ motivation skills
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	• 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	• Planning • Leading • Organizing • Coordinating • Communication Skills • Inter-and intra-person/ motivation skills
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***	• 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	• Planning • Leading • Organizing • Coordinating • Communication Skills • Inter-and intra-person/ motivation skills
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	• Organization's strategic plan, policies rules and regulations, laws and objectives for work unit activities and priorities • Organizations policies,	• Planning • Leading • Organizing • Coordinating • Communication Skills

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	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	strategic plans, guidelines related to the role of the work unit • Team work and consultation strategies	• Inter-and intra-person/ motivation skills
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	• 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	• Planning • Leading • Organizing • Coordinating • Communication Skills • Inter-and intra-person/ motivation skills

RANGE OF VARIABLES

VARIABLES	RANGE
1. Objectives	1.1. Specific 1.2. General
2. Resources	2.1. Personnel 2.2. Equipment and technology 2.3. Services 2.4. Supplies and materials 2.5. Sources for accessing specialist advice 2.6. Budget
3. Schedule of work activities	3.1. Daily 3.2. Work-based 3.3. Contractual 3.4. Regular 3.5. Confidential 3.6. Disclosure 3.7. Non-disclosure
4. Work methods and practices	Work methods and practices may include but not limited to: 4.1. Legislated regulations and codes of practice 4.2. Industry regulations and codes of practice 4.3. Occupational health and safety practices
5. Work plans	5.1. Daily work plans 5.2. Project plans 5.3. Program plans 5.4. Organization strategic and restructuring plans 5.5. Resource plans 5.6. Skills development plans 5.7. Management strategies and objectives
6. Standards	6.1. Performance targets 6.2. Performance management and appraisal systems 6.3. National competency standards 6.4. Employment contracts 6.5. Client contracts 6.6. Discipline procedures 6.7. Workplace assessment guidelines 6.8. Internal quality assurance 6.9. Internal and external accountability and auditing requirements 6.10. Training Regulation Standards 6.11. Safety Standards
7. Appropriate personnel/authorities	7.1. Appropriate personnel include: 7.2. Management 7.3. Line Staff
8. Feedback mechanisms	8.1. Feedback mechanisms include: 8.2. Verbal feedback 8.3. Informal feedback 8.4. Formal feedback 8.5. Questionnaire 8.6. Survey 8.7. Group discussion

EVIDENCE GUIDE

1. Critical aspects of Competency	**Assessment requires evidence that the candidate:** 1.1. Set objectives 1.2. Planned and scheduled work activities 1.3. Implemented work plans 1.4. Monitored work activities 1.5. Reviewed and evaluated work plans and activities
2. Resource Implications	**The following resources should be provided:** 2.1. Tools, equipment and facilities appropriate to the proposed activities 2.2. Materials relevant to the proposed activities 2.3. Work plan schedules 2.4. Drawings, sketches or blueprint
3. Methods of Assessment	**Competency in this unit may be assessed through:** 3.1. Direct observation/questioning 3.2. Practical exercises on Planning and Scheduling Work Activities 3.3. Third Party Report (collection of competency evidence)
4. Context for Assessment	Competency may be assessed in the workplace or in simulated work

UNIT OF COMPETENCY : PROMOTE ENVIRONMENTAL PROTECTION

UNIT CODE : 500311120

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required in adhering to environmental protection principles, strategies and guidelines

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Study guidelines for environmental concerns	1.1 Environmental **legislations/ conventions** and local ordinances are identified according to the different ***environmental aspects/impact*** 1.2 ***Industrial standard/ environmental practices*** are described according to the different environmental concerns	• Features of an environmental management strategy • Environmental issues/concerns • International Environmental Protocols (Montreal, Kyoto) • Waste minimization hierarchy • Environmental planning/ management • Community needs and expectations • Resource availability • Environment-friendly/ environmental advocates • Sanitary Code • Environmental Code of practice	• Communicating effectively • Performing research and analysis • Reading / interpreting data and information • Problem solving
2. Implement specific environmental programs	2.1 ***Programs/Activities*** are identified according to organizations policies and guidelines. 2.2 Individual roles/ responsibilities are determined and performed based on the activities identified. 2.3 Problems/ constraints encountered are resolved in accordance with organizations' policies and guidelines 2.4 Stakeholders are consulted based on company guidelines	• Features of an environmental management strategy • Waste minimization hierarchy • Environmental planning/ management • Community needs and expectations • Resource availability • Environment-friendly/ environmental advocates • 5S of Good Housekeeping • 3Rs – Reduce, Reuse & Recycle	• Communicating effectively • Performing research and analysis • Reading / interpreting data and information • Problem solving

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Monitor activities on environmental protection/ programs	3.1 Activities are ***periodically*** monitored and evaluated according to the objectives of the environmental program 3.2 Feedback from stakeholders are gathered and considered in proposing enhancements to the program based on consultations 3.3 Data gathered are analyzed based on evaluation requirements 3.4 Recommendations are submitted based on the findings 3.5 Management support systems are set/ established to sustain and enhance the program 3.6 Environmental incidents are monitored and reported to concerned/proper authorities	• Features of an environmental management strategy • Environmental issues/concerns • International Environmental Protocols (Montreal, Kyoto) • Waste minimization hierarchy • Environmental planning/ management • Community needs and expectations • Resource availability • Environment-friendly/ environmental advocates • 5S of Good Housekeeping • 3Rs – Reduce, Reuse & Recycle • Sanitary Code • Environmental Code of practice	• Communicating effectively • Performing research and analysis • Reading / interpreting data and information • Problem solving

RANGE OF VARIABLES

VARIABLES	R A N G E
1. Legislations/Conventions	May include: 1.1 Clean Air act 1.2 Clean Water Act 1.3 Solid Waste Management 1.4 Montreal Protocol 1.5 Kyoto Protocol
2. Environmental aspects/impacts	2.1 Air pollution 2.2 Water pollution 2.3 Noise pollution 2.4 Solid waste 2.5 Flood control 2.6 Deforestation/Denudation 2.7 Radiation/Nuclear /Radio Frequency/ Microwaves 2.8 Situation 2.9 Soil erosion (e.g. Quarrying, Mining, etc.) 2.10 Coral reef/marine life protection
3. Industrial standards/ Environmental practices	3.1 ECC standards 3.2 ISO standards 3.3 company environmental management systems (EMS)
4. Periodic	4.1 hourly 4.2 daily 4.3 weekly 4.4 monthly 4.5 quarterly 4.6 yearly
5. Programs/Activities	5.1 Waste disposal (on-site and off-site) 5.2 Repair and maintenance of equipment 5.3 Treatment and disposal operations 5.4 Clean-up activities 5.5 Laboratory and analytical test 5.6 Monitoring and evaluation 5.7 Environmental advocacy programs

EVIDENCE GUIDE

1. Critical aspects of Competency	**Assessment requires evidence that the candidate:** 1.1 Demonstrated knowledge of environmental legislations and local ordinances according to the different environmental issues/concerns. 1.2 Described industrial standard environmental practices according to the different environmental issues/concerns. 1.3 Resolved problems/ constraints encountered based on management standard procedures 1.4 Implemented and monitored environmental practices on a periodic basis as per company guidelines 1.5 Recommended solutions for the improvement of the program 1.6 Monitored and reported to proper authorities any environmental incidents
2. Resource Implications	**The following resources should be provided:** 2.1 Workplace/Assessment location 2.2 Legislation, policies, procedures, protocols and local ordinances relating to environmental protection 2.3 Case studies/scenarios relating to environmental protection
3. Methods of Assessment	**Competency in this unit may be assessed through:** 3.1 Written/ Oral Examination 3.2 Interview/Third Party Reports 3.3 Portfolio (citations/awards from GOs and NGOs, certificate of training – local and abroad) 3.4 Simulations and role-plays
4. Context for Assessment	Competency may be assessed in actual workplace or at the designated TESDA center.

COMMON COMPETENCIES

UNIT TITLE : USE HAND TOOLS
UNIT CODE : ELC311205
UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes on the safe use, handling and maintenance of tools.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Plan and prepare for tasks to be undertaken	1.1. Tasks to be undertaken are properly identified 1.2. Appropriate ***hand tools*** are identified and selected according to the task requirements	• Planning and preparing task/activity • Electronics hand tools and their uses • Function, operation and common faults in electronics hand tools	• Preparing required tasks • Communication skills • Using hand tools properly
2. Prepare hand tools	2.1. Appropriate hand tools are checked for proper operation and safety 2.2. Unsafe or faulty tools are identified and marked for repair according to standard company procedure	• Checking and safety requirements in handling tools • Standard procedures in checking, identification and marking of safe or unsafe/ faulty tools	• Identifying and checking hand tools • Marking of safe or unsafe/ faulty hand tools

3. Use appropriate hand tools and test equipment	3.1. Tools are used according to tasks undertaken
	3.2. All safety procedures in using tools are observed at all times and appropriate ***personal protective equipment*** (PPE) are used
	3.3. Malfunctions, unplanned or unusual events are reported to the supervisor
		• Safety requirements in using electronics hand tools and test equipment
		• Electronics hand tools for adjusting, dismantling, assembling, finishing, and cutting.
		• Processes, Operations, Systems
		  ○ Proper usage and care of hand tools
		  ○ Types and uses of test equipment
		• Common faults in the use of hand tools
			• Reading skills required to interpret work instruction and numerical skills
			• Using PPE properly
			• Problem solving in emergency situation

4. Maintain hand tools	4.1. Tools are handled without damage according to procedures.
	4.2. Routine ***maintenance*** of tools is undertaken according to standard operational procedures, principles and techniques
	4.3. Tools are stored safely in appropriate locations in accordance with manufacturer's specifications or standard operating procedures
		• Safety requirements in maintenance of hand tools
		• Processes, Operations, Systems
		  ○ Maintenance of tools
		  ○ Storage of hand tools
			• Checking and cleaning hand tools
			• Storing hand tools properly

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hand tools	Hand tools for adjusting, dismantling, assembling, finishing, cutting. Tool set includes the following but not limited to: screw drivers, pliers, punches, wrenches, files
2. Personal Protective Equipment (PPE)	2.1. Gloves 2.2. Protective eyewear 2.3. Apron/overall
3. Maintenance	3.1. Cleaning 3.2. Lubricating 3.3. Tightening 3.4. Simple tool repairs 3.5. Hand sharpening 3.6. Adjustment using correct procedures

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment must show that the candidate: 1.1. Demonstrated safe working practices at all times 1.2. Communicated information about processes, events or tasks being undertaken to ensure a safe and efficient working environment 1.3. Planned tasks in all situations and reviewed task requirements as appropriate 1.4. Performed all tasks to specification 1.5. Maintained and stored tools in appropriate location
2. Method of assessment	Competency in this unit must be assessed through: 2.1. Observation 2.2. Oral questioning
3. Resource Implication	Tools may include the following but not limited to: 3.1 screw drivers 3.2 pliers 3.3 punches 3.4 wrenches, files
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT TITLE : PERFORM MENSURATION AND CALCULATION
UNIT CODE : ELC311201
UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes and values needed identify, care, handle and use measuring instruments

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Select measuring instruments	1.1. Object or component to be measured is identified, classified and interpreted to the appropriate regular ***geometric shape*** 1.2. Measuring tools are selected in line with job requirements 1.3. Correct specifications are obtained from relevant source 1.4. Appropriate ***measuring instrument*** is selected to achieve required outcome 1.5. Alternative measuring tools are used without sacrificing cost and quality of work	• Category of measuring instruments • Types and uses of measuring instruments • Shapes and Dimensions • Formulas for volume, areas, perimeters of plane and geometric figures	• identifying and selecting measuring instruments • Visualizing objects and shapes
2. Carry out measurements and calculation	2.1. Accurate ***measurements and calculations*** are obtained for job 2.2. Calculation needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x), and division (/) 2.3. Calculation involving fractions, percentages and mixed numbers are used to complete workplace tasks. 2.4. Numerical computation is self-checked and corrected for accuracy 2.5. Instruments are read to the limit of accuracy of the tool. 2.6. Systems of measurement identified and converted according to job requirements/ISO 2.7. Work pieces are measured according to job requirements	• Calculation & measurement • Four fundamental operation • Linear measurement • Dimensions • Unit conversion • Ratio and proportion	• Performing calculation by addition, subtraction, multiplication and division; • Interpreting formulas for volume, areas, perimeters of plane and geometric figures • Handling of measuring instruments

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Maintain measuring instruments	3.1. Measuring instruments are not dropped to avoid damage 3.2. Measuring instruments are cleaned before and after using. 3.3. Proper storage of instruments undertaken according to manufacturer's specifications and standard operating procedures.	• Types of measuring instruments and their uses • Safe handling procedures in using measuring instruments • Four fundamental operation of mathematics • Formula for volume, area, perimeter and other geometric figures	• Handling and maintaining measuring instruments

RANGE OF VARIABLES

VARIABLE	RANGE	
1. Geometric Shape	Including but I not limited to: 1.1 Round 1.2 Square 1.3 Rectangular 1.4 Triangle 1.5 Sphere 1.6 Conical	
2. Measuring instruments	Including but not limited to: 2.1 Micrometer (In-out, depth) 2.2 Vernier caliper (out, inside) 2.3 Dial gauge with mag, std. 2.4 Straight edge 2.5 Thickness gauge 2.6 Torque gauge 2.7 Small hole gauge 2.8 Telescopic gauge	2.9 Try-square 2.10 Protractor 2.11 Combination gauge 2.12 Steel rule 2.13 Voltmeter 2.14 Ammeter 2.15 Mega-ohmmeter 2.16 KWH meter 2.17 Gauges 2.18 Thermometers
3. Measurements and calculations	3.1 Linear 3.2 Volume 3.3 Area 3.4 Wattage 3.5 Voltage 3.6 Resistance 3.7 Amperage 3.8 Frequency 3.9 Impedance 3.10 Conductance 3.11 Capacitance	3.12 Displacement 3.13 Inside diameter 3.14 Circumference 3.15 Length 3.16 Thickness 3.17 Outside diameter 3.18 Taper 3.19 Out of roundness 3.20 Oil clearance 3.21 End play/thrust clearance

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment must show that the candidate: 1.1. selected proper measuring instruments according to tasks 1.2. carried out measurement and calculations 1.3. maintained and stores instruments
2. Resource implication	2.1. Place of assessment 2.2. Measuring instruments 2.3. Straight edge 2.4. Torque gauge 2.5. Try square 2.6. Protractor 2.7. Combination gauge 2.8. Steel rule
3. Method of assessment	Competency should be assessed through: 3.1 Actual demonstration 3.2 Direct observation 3.3 Written test/questioning related to required knowledge
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT TITLE : PREPARE AND INTERPRET TECHNICAL DRAWING
UNIT CODE : ELC311202
UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes and values needed to prepare/interpret diagrams, engineering abbreviation and drawings, symbols, dimension.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Identify different kinds of technical drawings	1.1. Correct ***technical drawing*** is selected according to job requirements. 1.2. Technical drawings are segregated in accordance with the types and kinds of drawings	• Types of technical drawings • Applications for technical drawing • Methods of technical drawings • Symbols • Mark up/Notation of Drawings	• Reading skills required to interpret work instruction • Interpreting electrical/ electronic signs and symbols
2. Interpret technical drawing	2.1. Components, assemblies or objects are recognized as required. 2.2. ***Dimensions*** of the key features of the objects depicted in the drawing are correctly identified. 2.3. ***Symbols*** used in the drawing are identified and interpreted correctly. 2.4. Drawing is checked and validated against job requirements or equipment in accordance with standard operating procedures.	• Trade Mathematics o Linear measurement o Dimension o Unit conversion • Blueprint Reading and Plan Specification o Architectural, electrical, electronics, mechanical plan, symbols and abbreviations o Drawing standard symbols • Trade Theory o Basic technical drawing o Types technical plans o Various types of drawings o Notes and specifications	• Interpreting drawing/ orthographic drawing • Interpreting technical plans • Matching specification details with existing resources • Safety handling of drawing instruments
3. Prepare/make changes to electrical/ electronic schematics and drawings	3.1. Electrical/electronic schematic is drawn and correctly identified. 3.2. Correct drawing is identified, equipment are selected and used in accordance with job requirements.	• Drawing conventions • Dimensioning Conventions • Mathematics o Four fundamental operations o Percentage o Fraction o Algebra o Geometry	• Reading skills required to interpret work instruction • Communication skills • Preparing/Making electrical/ electronic signs and symbols • Computing formulas

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS

4. Store technical drawings and equipment/ instruments	4.1. Care and maintenance of drawings are undertaken according to company procedures.
	4.2. Technical drawings are recorded and inventory is prepared in accordance with company procedures.
	4.3. Proper storage of instruments is undertaken according to company procedures.
		• Effective ways to catalogue and store technical drawings
		• Manual methods of handling, storing and maintaining paper drawings
		• Storing drawing in digital forms
		  ○ Scanner
		  ○ CAD
			• Handling and storing of drawings
			• Scanning and storing drawings in digital form
			• Matching specification details with existing resources
			• Handling of drawing instruments

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technical drawings	Technical drawings include the following but not limited to: 1.1. Schematic diagrams 1.2. Charts 1.3. Block diagrams 1.4. Lay-out plans 1.5. Location plans 1.6. Process and instrumentation diagrams 1.7. Loop diagrams 1.8. System Control Diagrams
2. Dimensions	Dimensions may include but not limited to: 2.1. Length 2.2. Width 2.3. Height 2.4. Diameter 2.5. Angles
3. Symbols	May include but not limited to: 3.1. NEC- National Electric Code 3.2. IEC -International Electrotechnical Commission 3.3. ASME - American Society of Mechanical Engineers 3.4. IEEE - Institute of Electrical and Electronics Engineers 3.5. ISA - Instrumentation System and Automation Society
4. Instruments/Equipment	4.1. Components/dividers 4.2. Drawing boards 4.3. Rulers 4.4. T-square 4.5. Calculator

EVIDENCE GUIDE

1. Critical aspect of competencies	Assessment must show that the candidate: 1.1. selected correct technical drawing in line with job requirements 1.2. correctly identified the objects represented in the drawing 1.3. identified and interpreted symbols used in the drawing correctly 1.4. prepared/produced electrical/electronic drawings including all relevant specifications 1.5. stored diagrams/equipment
2. Method of assessment	Competency in this unit must be assessed through: 2.1. Practical tasks involving interpretation of a range of technical drawings 2.2. Oral questioning
3. Resource implication	3.1. Drawings 3.2. Diagrams 3.3. Charts 3.4. Plans
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT TITLE : APPLY QUALITY STANDARDS
UNIT CODE : ELC311204
UNIT DESCRIPTOR : This unit covers the knowledge, skills, (and) attitudes and values needed to apply quality standards in the workplace. The unit also includes the application of relevant safety procedures and regulations, organization procedures and customer requirements

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Assess quality of received materials or components	1.1. Work instructions are obtained and work is carried out in accordance with standard operating procedures 1.2. Received ***materials or component parts*** are checked against workplace standards and specifications 1.3. Faulty material or components related to work are identified and isolated 1.4. ***Faults*** and any identified causes are recorded and/or reported to the supervisor concerned in accordance with workplace procedures 1.5. Faulty materials or components are replaced in accordance with workplace procedures	• Relevant production processes, materials and products • Characteristics of materials, software and hardware used in production processes • Quality checking procedures • Quality Workplace procedures • Identification of faulty materials related to work	• Reading skills required to interpret work instruction • Critical thinking • Interpreting work instructions
2. Assess own work	2.1. ***Documentation*** relative to quality within the company is identified and used 2.2. Completed work is checked against workplace standards relevant to the task undertaken 2.3. Faulty pieces are identified and isolated 2.4. Information on the quality and other indicators of production performance is recorded in accordance with workplace procedures 2.5. In cases of deviations from specified ***quality standards***, causes are documented and reported in accordance with the workplace' standards operating procedures	• Safety and environmental aspects of production processes • Fault identification and reporting • Workplace procedure in documenting completed work • Workplace Quality Indicators	• Carry out work in accordance with OHS policies and procedures

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Engage in quality improvement	3.1. Process improvement procedures are participated in relation to workplace assignment 3.2. Work is carried out in accordance with process improvement procedures 3.3. Performance of operation or quality of product or service to ensure ***customer*** satisfaction is monitored	• Quality improvement processes • Company customers defined	• Solution providing and decision-making • Practice company process improvement procedure

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials/components	1.1. Materials may include but not limited to: 1.1.1. wires 1.1.2. cables, soldering lead 1.1.3. electrical tape 1.2. Components may include but not limited to: 1.2.1. ICs 1.2.2. Diodes
2. Faults	Faults may include but not limited to: 2.1. Components/materials not according to specification 2.2. Components/materials contain manufacturing defects 2.3. Components/materials do not conform with government regulation i.e., PEC, environmental code 2.4. Components/materials have safety defect
3. Documentation	3.1. Organization work procedures 3.2. Manufacturer's instruction manual 3.3. Customer requirements 3.4. Forms
4. Quality standards	Quality standards may relate but not limited to the following: 3.1 materials 3.2 component parts 3.3 final product 3.4 production processes
4 Customer	4.1 Co-worker 4.2 Supplier 4.3 Client 4.4 Organization receiving the product or service

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment must show that the candidate: 1.1. Carried out work in accordance with the company's standard operating procedures 1.2. Performed task according to specifications 1.3. Reported defects detected in accordance with standard operating procedures 1.4. Carried out work in accordance with the process improvement procedures
2. Method of assessment	The assessor may select two (2) of the following assessment methods to objectively assess the candidate: 2.1 Observation 2.2 Questioning 2.3 Practical demonstration
3. Resource implication	Materials and component parts and equipment to be used in a real or simulated electronic production situation
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment.

UNIT TITLE : PERFORM COMPUTER OPERATIONS
UNIT CODE : ELC311203
UNIT DESCRIPTOR : This unit covers the knowledge, skills, (and) attitudes and values needed to perform computer operations which include inputting, accessing, producing and transferring data using the appropriate hardware and software

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Plan and prepare for task to be undertaken	1.1. Requirements of task are determined 1.2. Appropriate ***hardware*** and ***software*** are selected according to task assigned and required outcome 1.3. Task is planned to ensure ***OH & S guidelines*** and procedures are followed	• Main types of computers and basic features of different operating systems • Main parts of a computer • Information on hardware and software • Data security guidelines	• Reading and comprehension skills required to interpret work instruction and to interpret basic user manuals. • Communication skills to identify lines of communication, request advice, follow instructions and receive feedback. • Interpreting user manuals and security guidelines
2. Input data into computer	2.1. Data are entered into the computer using appropriate program/application in accordance with company procedures 2.2. Accuracy of information is checked and information is saved in accordance with standard operating procedures 2.3. Inputted data are stored in ***storage media*** according to requirements 2.4. Work is performed within ***ergonomic guidelines***	• Basic ergonomics of keyboard and computer user • Storage devices and basic categories of memory • Relevant types of software	• Technology skills to use equipment safely including keyboard skills. • Entering data
3. Access information using computer	3.1. Correct program/ application is selected based on job requirements 3.2. Program/application containing the information required is accessed according to company procedures 3.3. ***Desktop icons*** are correctly selected, opened and closed for navigation purposes 3.4. Keyboard techniques are carried out in line with OH & S requirements for safe use of keyboards	• General security, privacy legislation and copyright • Productivity Application • Business Application	• Accessing information • Searching and browsing files and data

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
4. Produce/output data using computer system	4.1. Entered data are processed using appropriate software commands 4.2. Data printed out as required using computer hardware/peripheral devices in accordance with standard operating procedures 4.3. Files, data are transferred between compatible systems using computer software, hardware/ peripheral devices in accordance with standard operating procedures	• Computer application in printing, scanning and sending facsimile • Types and function of computer peripheral devices	• Computer data processing • Printing of data • Transferring files and data
5. Maintain computer equipment and systems	5.1. Systems for cleaning, minor ***maintenance*** and replacement of consumables are implemented 5.2. Procedures for ensuring security of data, including regular back-ups and virus checks are implemented in accordance with standard operating procedures 5.3. Basic file maintenance procedures are implemented in line with the standard operating procedures	• Computer equipment/ system basic maintenance procedures • Viruses • OH & S principles and responsibilities • Calculating computer capacity • System Software • Basic file maintenance procedures	• Removing computer viruses from infected machines • Making backup files

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hardware and peripheral devices	1.1. Personal computers 1.2. Networked systems 1.3. Communication equipment 1.4. Printers 1.5. Scanners 1.6. Keyboard 1.7. Mouse
2. Software	Software includes the following but not limited to: 2.1. Word processing packages 2.2. Data base packages 2.3. Internet 2.4. Spreadsheets
3. OH & S guidelines	3.1. OHS guidelines 3.2. Enterprise procedures
4. Storage media	Storage media include the following but not limited to: 4.1. diskettes 4.2. CDs 4.3. zip disks 4.4. hard disk drives, local and remote
5. Ergonomic guidelines	5.1. Types of equipment used 5.2. Appropriate furniture 5.3. Seating posture 5.4. Lifting posture 5.5. Visual display unit screen brightness
6. Desktop icons	Icons include the following but not limited to: 6.1. directories/folders 6.2. files 6.3. network devices 6.4. recycle bin
7. Maintenance	7.1. Creating more space in the hard disk 7.2. Reviewing programs 7.3. Deleting unwanted files 7.4. Backing up files 7.5. Checking hard drive for errors 7.6. Using up to date anti-virus programs 7.7. Cleaning dust from internal and external surfaces

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment must show that the candidate: 1.1. Selected and used hardware components correctly and according to the task requirement 1.2. Identified and explain the functions of both hardware and software used, their general features and capabilities 1.3. Produced accurate and complete data in accordance with the requirements 1.4. Used appropriate devices and procedures to transfer files/data accurately 1.5. Maintained computer system
2. Method of assessment	The assessor may select two of the following assessment methods to objectively assess the candidate: 2.1 Observation 2.2 Questioning 2.3 Practical demonstration
3. Resource implication	3.1. Computer hardware with peripherals 3.2. Appropriate software
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT TITLE : **TERMINATE AND CONNECT ELECTRICAL WIRING AND ELECTRONICS CIRCUIT**
UNIT CODE : **ELC311206**
UNIT DESCRIPTOR : This unit covers the knowledge, skills, (and) attitudes and values needed to terminate and connect electrical wiring and electronic circuits

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Plan and prepare for termination/ connection of electrical wiring/ electronics circuits	1.1. ***Materials*** are checked according to specifications and tasks 1.2. Appropriate ***tools and equipment*** are selected according to tasks requirements 1.3. Task is planned to ensure OH & S guidelines and procedures are followed 1.4. Electrical wiring/electronic circuits are correctly prepared for connecting/termination in accordance with instructions and work site procedures	• Use of tools • Use of test instruments / equipment • Electrical theory • Principals of AC and DC • OH & S guidelines and procedures • Basic electrical and electronic devices	• Reading skills required to interpret work instruction • Checking materials for conformance to specifications • Checking existing and new installation site for correct location and specification
2. Terminate/ connect electrical wiring/ electronic circuits	2.1. Safety procedures in using tools are observed at all times and appropriate ***personal protective equipment*** are used 2.2. All work undertaken safely in accordance with the workplace and standard procedures 2.3. Appropriate range of ***methods*** in termination/connection are used according to specifications, manufacturer's requirements and safety 2.4. Correct sequence of operation is followed 2.5. ***Accessories*** used are adjusted, if necessary 2.6. Confirm termination/connection undertaken successfully in accordance with job specification	• Wiring techniques • OH & S principles • Use of lead-free soldering technology • Specifications and methods for terminating different materials	• Communication skills • Marking, tagging and labeling requirements for cables, wires, conductors and connections

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Test termination/ connections of electrical wiring/ electronics circuits	3.1. Testing of all completed termination/ connections of electric wiring/electronic circuits is conducted for compliance with specifications and regulations using appropriate procedures and equipment 3.2. Wiring and circuits are checked using specified testing procedures 3.3. Unplanned events or conditions are responded to in accordance with established procedures	• AC and DC power supplies • Use of diagnostic equipment • Surface mount soldering techniques • Tests for wiring and connections • Wiring support techniques and alternatives	• Soldering techniques • Printed circuit board repair and techniques • Electronic assembly functional and quality testing • Undertaking testing of wiring and connections for conformance to specification • Using language and literacy skills to complete short reports and required • Adjusting and fixing wiring supports

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials	Materials included the following but not limited to: 1.1 Soldering lead 1.2 Cables 1.3 Wires
2. Tools and equipment	2.1 Tools for measuring, cutting, drilling, assembling/disassembling. Tool set includes the following but not limited to: 2.1.1 Pliers 2.1.2 Cutters 2.1.3 Screw drivers 2.2 Equipment 2.2.1 Soldering gun 2.2.2 Multi-tester
3. Personal protective equipment	3.1 goggles 3.2 gloves 3.3 apron/overall
4. Methods	4.1 Clamping 4.2 Pin connection 4.3 Soldered joints 4.4 Plugs
5. Accessories	Accessories may include the following but not limited to: 5.1 brackets 5.2 clamps

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment must show that the candidate: 1.1. Undertook work safely and according to workplace and standard procedures 1.2. used appropriate termination/ connection methods 1.3. followed correct sequence in termination / connection process 1.4. conducted testing of terminated connected electrical wiring/electronic circuits using appropriate procedures and standards
2. Method of assessment	The assessor may select two (2) of the following assessment methods to objectively assess the candidate: 2.1 Observation 2.2 Oral Questioning 2.3 Practical demonstration
3. Resource implication	Tools for measuring, cutting, drilling, assembling/disassembling, connecting. Tool set includes the following but not limited to: 3.1 screw drivers 3.2 pliers 3.3 cutters
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT OF COMPETENCY: **TEST ELECTRONIC COMPONENTS**

UNIT CODE : **ELC311209**

DESCRIPTON : This unit covers the knowledge, skills and attitudes required to test electronic components. It includes competencies in determining the criteria for testing electronics components, planning an approach for component testing, testing the components and evaluating the testing process.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Determine criteria for testing electronics components	1.1 Work instructions are obtained and clarified based on job order or client requirements 1.2 ***Responsible person*** is consulted for effective and proper work coordination 1.3 ***Data sheets/Application notes*** are obtained and interpreted based on manufacturer's specifications 1.4 ***Testing criteria*** are defined to ensure that components meet technical and quality requirements 1.5 Document and communicate testing criteria to relevant personnel	• Mensuration/ Mathematics o Conversion of Units o Applied Mathematics • Safety o Work Safety requirements and economy of materials with durability • Systems and Processes o Principles of electrical/ electronic circuits o Identifying sources of electricity o Identifying conductors and insulators o Supplying different voltage using variable power supply o Measuring resistance using VOM o Testing resistors o Measuring current and voltage using VOM • Testing Criteria o controls o effectiveness o efficiency o bug detection o functionality, including flow o interoperability o performance o reliability o operating parameters	• Work efficiently & systematically • Communication skills • Use and maintenance of tools and equipment • Skills in testing electronic components • Work safety practices and time management • Problem solving skills • Reading skills
2. Plan an approach for component testing	2.1 Various ***testing methods*** are Identified based on ***types of electronic components*** 2.2 Characteristics and appropriateness of testing methods to be used during development and on completion is	• Safety o Work Safety requirements and economy of materials with durability o Knowledge in 5S application and observation of required timeframe	• Work efficiently & systematically • Communication skills • Use and maintenance of tools and equipment • Skills in testing

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	determined 2.3 Testing methods are considered/selected in relation to appropriate ***testing strategy*** 2.4 Plan for testing components is developed at specified points during development and on completion 2.5 Required ***test & measuring instruments*** and ***tools*** are prepared and checked in accordance with established procedures 2.6 ***Records system*** is established to document testing results, including problems and faults	• Materials, tools and equipment uses and specifications o Proper care and use of tools • Types of electronic components o Passive components o Active components o Dynamic components o Hybrid components • Testing methods o automated o debugging o inspection o platform testing o prototyping • Systems and Processes o Describing resistance and identify resistors o Describing alternating current circuits o Describing capacitance and identifying capacitors o Describing inductance and identifying inductors o describing the characteristic of transformers o describing and identifying semiconductor diode o describing and identifying bipolar transistor o describing and analyzing digital gate	electronic components • Work safety practices and time management • Problem solving skills • Reading skills
3. Test components	3.1 Testing methods are applied to ensure that products meet creative, production and technical requirements 3.2 Problems and faults detected by testing are recorded and remedial steps taken in records system is documented 3.3 Problems and faults detected during testing are resolved in accordance with agreed	• Safety o Work Safety requirements and economy of materials with durability • Materials, tools and equipment uses and specifications o Proper care and use of tools • Systems and Processes o Principles of electrical/ electronic circuits o Supplying different	• Work efficiently & systematically • Communication skills • Use and maintenance of tools and equipment • Skills in testing electronic components • Work safety practices and

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	project or industry practice 3.4 Evaluate final products against the previously determined criteria 3.5 Testing process is documented and summarized evaluation report is submitted to relevant personnel	voltage using variable power supply ○ Measuring resistance using VOM ○ Testing resistors ○ Measuring current and voltage using VOM ○ Observing waveform using oscilloscope ○ generating waveform in various frequency using function generator ○ Measuring frequency using oscilloscope ○ Measuring capacitance using VOM ○ Testing capacitors ○ Testing inductors ○ testing semiconductor diode ○ testing bipolar transistor ○ testing logic gates	time management • Problem solving skills • Reading skills
4 Evaluate the testing process	4.1 Testing methods that were successful and those that led to difficulties are identified based on industry standards 4.2 Testing process and records system are evaluated based on standard procedures 4.3 Test results/findings are documented for subsequent components testing.	• Evaluation of testing process and records system • Systems and Processes ○ Analyzing simple circuit using ohms and power law ○ Analyzing series/parallel circuits using ohms and power law ○ Analyzing series/parallel capacitances ○ analyzing series parallel inductors ○ analyzing rectifier circuits ○ analyzing amplifier circuit ○ analyzing multi-vibrator circuit ○ analyzing logic networks ○ analyzing sequence circuits	• Work efficiently & systematically • Communication skills • Use and maintenance of tools and equipment • Skills in testing electronic components • Work safety practices and time management • Problem solving skills • Reading skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. Responsible person	Relevant personnel may include: 1.1. Immediate supervisor 1.2. Manager
2. Testing criteria	Testing criteria may include: 2.1. controls 2.2. effectiveness 2.3. efficiency 2.4. bug detection 2.5. functionality, including flow 2.6. interoperability 2.7. performance 2.8. reliability 2.9. operating parameters
3. Testing methods	Testing methods may include: 3.1. automated 3.2. debugging 3.3. inspection 3.4. platform testing 3.5. prototyping
4. Types of electronic components	4.1. Passive components 4.2. Active components 4.3. Dynamic components 4.4. Hybrid components
5. Testing strategy	Testing strategy may be determined by: 5.1. Passive testing 5.2. Dynamic testing 5.3. In-circuit testing
6. Test and measuring instruments	Test and measuring instruments may include: 6.1. Variable DC power supply 6.2. Digital VOM 6.3. analog VOM 6.4. dual trace triggered oscilloscope 6.5. function generator
7. Tools	Tools may include: 7.1. set of pliers 7.2. set of screw drivers 7.3. set of wrenches 7.4. Hand drills, 7.5. Hack saw 7.6. set of files 7.7. tin snip 7.8. hammer

8. Records system	Records system may include: 8.1. metadata that includes: 8.1.1. description of fault 8.1.2. identification of code 8.1.3. user responses 8.1.4. written or verbal comments 8.1.5. quantitative data 8.1.6. remedial action taken 8.1.7. retest result 8.1.8. date 8.1.9. tester's details 8.2. questionnaire 8.3. survey

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Determined criteria for testing electronics components 1.2 Planned an approach for component testing 1.3 Tested components 1.4 Evaluated the testing process
2 Method of assessment	Competency may be assessed through two or more of the following methods: 2.1 Direct observation of application to tasks and questions related to required knowledge 2.2 Demonstration with oral questioning 2.3 Third party report 2.4 Written test 2.5 Portfolio
3 Resource implications	The following resources must be provided: 3.1 Tools and equipment (see range of variables) 3.2 Working area/bench 3.3 Electronic components 3.4 Testing instruments and equipment 3.5 Assessment rating sheet 3.6 Reporting forms
4 Context of assessment	Assessment maybe conducted in the workplace or in a simulated workplace setting

CORE COMPETENCIES

UNIT TITLE : **DEVELOP ADVANCED PLC AND HMI APPLICATION PROGRAM**

UNIT CODE : **ELC311306**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes necessary to develop, analyze, implement and review advanced PLC and HMI application programs in line with requirements, software specifications and applications. This includes competencies in preparing advanced PLC and HMI application program as well as testing and documenting the developed advanced PLC and HMI application program.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS

1. Prepare advanced PLC and HMI application program	1.1. Advanced PLC and HMI application program is prepared using appropriate code.
	1.2. Advanced PLC and HMI application program is ***debugged*** and reworked for correction of errors
	1.3. Appropriate ***ergonomic standards*** are observed to reduce fatigue while working on a computer
		• Advanced PLC application program
		  ○ Program organization
		  ○ Data types
		  ○ Variables
		  ○ Configuration
		• HMI application program
		  ○ HMI layout
		  ○ Screen development
		  ○ Drawing tools
		  ○ PLC and HMI interfacing
		  ○ Basic HMI tools
		• Advanced PLC and HMI analog program instructions
		• Advanced PLC and HMI
		• Communication setup and networking
		• Advanced PLC program instructions
		  ○ Relay
		  ○ Timer
		  ○ Counter
		  ○ Math instructions
		  ○ Data manipulation
		  ○ Program control
		• Ergonomic guidelines/ standards
		  ○ Movement space
		  ○ Furniture dimensions
		  ○ Working postures
		  ○ Illumination and glare
		• PLC program debugging techniques
		  ○ Online
		  ○ Off-line
			• Skills in computer operation
			• Advanced PLC programming skills
			• Debugging skills
			• Documentation skills
			• Analytical skills

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS

		• Logic circuit analysis and development
		  ○ Sequential circuit
		  ○ Ladder circuit
		• Operation process flowcharting
		• Standard programming languages [i.e. Ladder, Function block diagram (FBD), Instructions list (IL), Sequential function flowchart (SFC), Structured Text Language (STL)]	

2. Test developed Advanced PLC and HMI application program	2.1. Developed advanced PLC and HMI application program is run to ensure all syntax errors are corrected. 2.2. Program is downloaded using manufacturer's procedures. 2.3. Any limits, exceptions and other aspects built into the control circuits, advanced PLC and HMI application program are tested against user's control requirements. 2.4. Advanced PLC and HMI application program is tested for user's acceptance	• Advanced PLC and HMI interfacing • Communication and configuration protocol for advanced PLC and HMI • Downloading and uploading procedures of advanced PLC and HMI software program • Standard operating procedures for advanced PLC and HMI application program • Testing and commissioning procedures for control circuits, advanced PLC and HMI application program	• Skills in computer operation • PLC and HMI programming skills • Debugging skills • Analytical skills • Testing and commissioning skills

3. Document advanced PLC and HMI application program developed	3.1. Final control circuits, advanced PLC and HMI application program flow or flowchart are prepared according to company standards.
	3.2. ***Labels and comments*** are included in the program for user–friendliness.
	3.3. Final revision of the advanced PLC and HMI application program and external devices assignment are prepared in softcopy and printed formats
		• Computer software applications
		  ○ Computer Aided Design (CAD)
		  ○ Microsoft office application
		• Tagging and labeling of program components
		• Exporting advanced PLC and HMI software program
		• Compilation of softcopy and printed formats
			• Skills in computer operation
			• Documentation skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. Language	Include but not limited to: 1.1. Standard Programming languages 1.1.1 Ladder 1.1.2 Function block diagram (FBD) 1.1.3 Instructions list (IL) 1.1.4 Sequential function flowchart (SFC) 1.1.5 Structured Text Language (STL) 1.2. Procedural language
2. Ergonomic guidelines/ standards	Include but not limited to: 2.1. Movement space 2.2. Furniture dimensions 2.3. Working postures 2.4. Illumination and glare
3. Debugging	PLC program debugging techniques: 3.1. Online 3.2. Off-line
4. Labels and comments	Include but not limited to: 5.1 Elements tagging 5.2 Labeling 5.3 Remarks and description

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1. Prepared advanced PLC and HMI application program using appropriate code 1.2. Develop advanced PLC and HMI analog program instructions 1.3. Downloaded program using manufacturer's procedures 1.4. Run developed advanced PLC and HMI application program to ensure all syntax errors are corrected. 1.5. Tested developed advanced PLC and HMI application program for user's acceptance 1.6. Debugged & tested the developed application program 1.7. Prepared final revision of the advanced PLC and HMI application program in softcopy and printed formats.
2. Method of assessment	The assessor may select two of the following assessment methods to objectively assess the candidate: 2.1 Practical Demonstration with Oral questioning 2.2 Written Examination 2.3 Direct Observation with Oral questioning
3. Resource Implication	3.1. Computer hardware with peripherals 3.2. Software application programs 3.3. Appropriate motion control equipment 3.4. Materials
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated work process and procedures

UNIT TITLE : **COMMISSION ADVANCED PLC- AND HMI-BASED MECHATRONICS AND AUTOMATION SYSTEMS**

UNIT CODE : **ELC311307**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes necessary to undertake the commissioning of advanced PLC- and HMI-based mechatronics and automation systems. This includes planning and preparing to undertake commissioning process, commissioning and testing mechatronics and automation systems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS

1. Plan and prepare for commissioning activities	1.1. Commissioning procedures are planned and prepared in line with job requirements.
	1.2. ***OH & S policies and procedures*** are followed in line with job requirements.
	1.3. Commissioning procedures are checked against specifications and requirements
	1.4. ***Tools, equipment*** **and** ***testing devices*** needed are obtained and checked for correct operation and safety.
	1.5. ***Materials*** necessary are obtained in accordance with job requirements
		• Use of tools
		• Use of test equipment/ instrument
		• Knowledge in block diagram of the advanced PLC/ HMI system
		• Occupational health and safety
		• Loop checking based on design specifications
		• Tools, equipment and testing devices
		  ○ Multitester/
		  ○ Laptop / PC
		  ○ Advanced PLC programmer/ software
		  ○ Human Machine Interface (HMI)
		  ○ PLC
		• Materials
		• Communication/ Interface cables
			• Reading skills required to understand work instructions
			• Diagram interpretation skills
			• Communication skills
			• Planning skills

2. Commission mechatronics and automation system	2.1. Appropriate ***personal protective equipment*** (PPE) is used and OHS policies & procedures are followed.
	2.2. Mechatronics and automation system are checked using specified procedures
	2.3. Commissioning procedure is performed in accordance with requirements without damage to the surrounding environment or services
		• Knowledge on PPE and OHS policies and procedures
		• Knowledge on control circuits
		  ○ Electro-mechanical
		  ○ Pneumatic & electro-pneumatic
		  ○ Electro-hydraulic
		• Knowledge on verification of system setup based on design & expected output and performance
		• Advanced PLC operation & application
		• Field and control devices
			• Occupational and safety skills
			• Reading skills required to understand work instructions
			• Diagram interpretation skills
			• Communication skills
			• Commissioning skills
			• Programming skills
			• Visual skills

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	2.4. Unplanned events or conditions are responded to in accordance with established procedures	• Advance Computer programming • Advanced PLC programming • Motion control systems • Knowledge on equivalent replacement of parts and equipment • Knowledge on different approaches on system setup	
3. Document commissioned mechatronics and automation system	3.1. Commissioned mechatronics and automation system is documented according to established procedures or manufacturer's instructions. 3.2. Report on the commissioning activities is prepared according to the company requirements.	• Knowledge on documentation of commissioned mechatronics and automation system • Knowledge on different types of technical reports ○ Pre-commissioning report ○ Compliance output report	• Computer operation skills • Communication skills • Documentation skills • Technical writing skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. OH & S policies and procedures	1.1. Occupational Safety, Health and Environment (OSHE) guidelines 1.2. Philippine environmental standards
2. Mechatronics systems	Includes the following but not limited to: 2.1. Sensoric elements 2.2. Electro-mechanical elements 2.3. Pneumatic & electro-pneumatic elements 2.4. Hydraulic elements 2.5. Actuators & output devices
3. Tools	Includes the following but not limited to: 3.1. Pliers; assorted 3.2. Screwdrivers; assorted 3.3. Soldering iron
4. Test equipment/instruments	Includes the following but not limited to: 4.1. Multi-tester 4.2. Laptop/PC
5. Materials	Includes the following but not limited to: 5.1. Wires 5.2. Terminal lugs 5.3. Terminal wire marker 5.4. Terminal blocks
6. Personal protective equipment	6.1. Safety hat 6.2. Safety shoes 6.3. Ear muffs 6.4. Goggles 6.5. Safety belt/Harness 6.6. Gloves 6.7. Mask

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment must show that the candidate: 1.1. Planned and prepared commissioning procedures in line with job requirements 1.2. Performed commissioning procedure in accordance with requirements without damage to the surrounding environment or services 1.3. Checked and tested the commissioned mechatronics and automation system according to procedures & manufacturer's instructions 1.4. Prepared documentation on commissioned mechatronics and automation in accordance to the established procedures or manufacturer's instructions
2. Method of assessment	The Assessor may select two of the following assessment methods to objectively assess the candidate: 2.1 Practical Demonstration with Oral questioning 2.2 Written Examination 2.3 Direct Observation with Oral questioning
3. Resource Implication	3.1. Tools 3.2. Test equipment/instruments 3.3. PPE 3.4. Materials 3.5. Mechatronics and automation equipment 3.6. Technical Manuals
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

UNIT TITLE : **DIAGNOSE AND TROUBLESHOOT ADVANCED PLC- AND HMI-BASED MECHATRONICS AND AUTOMATION SYSTEMS**

UNIT CODE : **ELC311308**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes needed to diagnose and troubleshoot defects in Mechatronics and automation systems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized Bold*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Plan and prepare for diagnosis and troubleshooting of faults in mechatronics and automation systems	1.1. Diagnosis and troubleshooting of faults is planned and prepared in line with job requirements 1.2. ***OH & S policies and procedures*** are followed in line with job requirements 1.3. Authorized personnel are consulted to coordinate the work effectively 1.4. ***Materials*** necessary are obtained in accordance with established procedures and job requirements 1.5. ***Tools, equipment and testing devices*** needed are obtained in accordance with job requirements and checked for proper operation and safety. 1.6. ***Mechatronics system*** faults are checked against job requirements.	• Planning and preparing diagnosis of faults • Occupational health and safety • Diagnostic and troubleshooting procedures • Work place communication • Identification of diagnostic materials o Wires o Terminal lugs o Terminal Blocks o Wire Marker • Use of tools • Use of test equipment/ instruments • Motion Control and Control circuits • Advanced PLC and HMI mechatronics and automation system o Sensor elements o Electro-mechanical elements o Pneumatic & electro-pneumatic elements o Hydraulic elements o Actuators & output devices	• Diagnostic skills and troubleshooting techniques • Reading skills required to understand work instructions • Diagram interpretation skills • Communication skills • Problem solving skills
2. Diagnose and troubleshoot faults of mechatronics and automation systems	2.1 Appropriate ***personal protective equipment*** is used and OHS policies & procedures are followed 2.2 Fault or problem in the mechatronics system is diagnosed and troubleshoot in line with the standard operating procedures and technical requirements.	• Knowledge on PPE and OHS • Knowledge on advanced PLC and HMI mechatronics and automation system diagnostic and troubleshooting • Knowledge & interpretation of	• Diagnostic skills • Reading skills required to understand work instructions • Diagram interpretation skills • Communication skills • Problem solving

ELEMENT	PERFORMANCE CRITERIA ***Italicized Bold*** terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	2.3 Contingency measures are managed and implemented in accordance with established procedures 2.4 Unplanned events or conditions are responded to in accordance with established procedures	manufacturer's/ company contingency measures • Knowledge on problems and faults • Fault finding techniques • Out-of-control action plan (OCAP) on unplanned events or conditions	skills • Troubleshooting skills
3. Rectify/ Correct faults in the mechatronics and automation system	3.1. Appropriate personal protective equipment is used and OH & S policies & procedures are followed 3.2. Systems and associated equipment are isolated, when necessary, in accordance with established procedures 3.3. Defective components or parts are replaced or corrected without damage to the surrounding environment or services 3.4. Adjustments are made in accordance with established procedures, where necessary. 3.5. Unplanned events or conditions are responded to in accordance with established procedures.	• Knowledge in product replacement and specification • Equipment isolation technique and procedures • Components and parts specification • Components and parts visual inspection • Contingency procedures on unplanned events or conditions at fault correction and rectification	• Diagnostic skills • Analytical skills • Reading skills required to understand work instructions • Diagram interpretation skills • Communication skills • Problem solving skills • Troubleshooting skills
4. Test and document the corrected mechatronics and automation system	4.1 Mechatronics and automation system and associated equipment are tested using specified testing procedures as per manufacturer's instructions. 4.2 Mechatronics and automation system and associated equipment are checked to ensure safe operation. 4.3 Unplanned events or conditions are responded to in accordance with established procedures. 4.4 Documentation is prepared/ completed in accordance with company requirements	• Manufacturer's testing procedures • Advanced PLC and HMI mechatronics and automation systems operation procedures • Contingency procedures on unplanned events or conditions on testing corrected system • Knowledge on technical reports especially testing and commissioning report	• Diagnostic skills • Reading skills required to understand work instructions • Diagram interpretation skills • Communication skills • Problem solving skills • Troubleshooting skills • Documentation skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. OH & S policies and procedures	1.1. OH & S guidelines 1.2. Philippine environmental standards
2. Materials	Includes the following but not limited to: 2.1. Wires 2.2. Terminal lugs 2.3. Terminal wire marker 2.4. Terminal blocks
3. Tools	Includes the following but not limited to: 3.1. Pliers; assorted 3.2. Screwdrivers; assorted 3.3. Soldering iron
4. Test equipment/instruments	Includes the following but not limited to: 4.1. Multi-tester 4.2. Programmers or PC
5. Mechatronics Systems	Includes the following but not limited to: 5.1. Sensor elements 5.2. Electro-mechanical elements 5.3. Pneumatic & electro-pneumatic elements 5.4. Hydraulic elements 5.5. Actuators & output devices
6. Personal protective equipment	6.1. Safety hat 6.2. Safety shoes 6.3. Ear muffs 6.4. Goggles 6.5. Safety belt/Harness 6.6. Gloves 6.7. Mask

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment must show that the candidate: 1.1. Planned and prepared diagnosis and troubleshooting of faults in line with job requirements 1.2. Diagnosed and troubleshoot fault or problem in the mechatronics system is in line with job requirements 1.3. Managed and implemented contingency measures in accordance with established procedures 1.4. Checked and tested mechatronics and automation system and associated equipment using specified testing procedures as per manufacturer's instructions 1.5. Rectified/Corrected faults in the mechatronics and automation system 1.6. Prepared/completed documentation in accordance with the company requirements
2. Method of assessment	The Assessor may select two of the following assessment methods to objectively assess the candidate: 2.1 Practical Demonstration with Oral questioning 2.2 Written Examination 2.3 Direct Observation with Oral questioning
3. Resource Implication	3.1. Tools 3.2. Test instruments/equipment 3.3. PPE 3.4. Mechatronic equipment 3.5. Materials 3.6. Technical Manuals
4. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment.

SECTION 3 TRAINING ARRANGEMENTS

This set of standards provides Technical and Vocational Education and Training (TVET) providers with information and other important requirements to consider when designing training programs for Mechatronics Servicing NC IV.

This includes information on curriculum design; training delivery; trainee entry requirements; tools and equipment; training facilities; and trainer's qualification and institutional assessment.

3.1 CURRICULUM DESIGN

TESDA shall provide the training on the development of competency-based curricula to enable training providers develop their own curricula with the components mentioned below.

Delivery of knowledge requirements for the basic, common and core units of competency specifically in the areas of mathematics, science/technology, communication/language and other academic subjects shall be contextualized. To this end, TVET providers shall develop a Contextual Learning Matrix (CLM) to accompany their curricula.

Course Title: Mechatronics and Automation Servicing **NC Level:** NC IV

Nominal Training Duration:

30 hrs – Basic Competencies
64 hrs – Common Competencies
106 hrs – Core Competencies
---
200 hrs

Course Description:

This course is designed to develop & enhance the knowledge, skills, & attitudes of a Mechatronics Technician, in accordance with industry standards. It covers the basic & common competencies in addition to the core competencies such as developing advanced PLC and HMI software programs, performing commissioning, diagnostics & troubleshooting on advanced PLC- and HMI-based mechatronics and automation systems.

(*The nominal duration of 200 hours covers only the basic, common and core units at Mechatronics Servicing NC IV level. TVET providers can however, offer a longer, ladderized course covering NC II, NC III and NC IV basic, common and core units.)*

BASIC COMPETENCIES

30 hrs

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
1. Utilize specialized communication skills	1.1 Meet common and specific communication needs of clients and colleagues	▪ Read o Communication process o Dynamics of groups and different styles of group leadership ▪ Identify different approaches to meet the needs of clients and colleagues	▪ Lecture	▪ Written examination	1 hr.
	1.2 Contribute to the development of communication strategies	▪ Apply communication skills to fulfill job roles as specified by the organization	▪ Demonstration	▪ Observation	1 hr.
		▪ Apply communication techniques in communicating with clients and colleagues o Active listening o Feedback o Interpretation o Role boundaries setting o Negotiation o Establishing empathy	▪ Demonstration	▪ Observation	
		▪ Describe strategies for internal and external dissemination of information	▪ Group discussion	▪ Oral evaluation	
	1.3 Represent the organization	▪ Describe criteria for a good presentation ▪ Prepare presentation material for internal or external forums to promote the organization ▪ Use appropriate media to enhance the presentation	▪ Demonstration	▪ Observation	1 hr.

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
	1.4 Facilitate group discussion	▪ Gather relevant information ▪ Apply values in facilitating differences in views	▪ Demonstration	▪ Observation	1 hr.
	1.5 Conduct interview	▪ Describe communication strategies employed in interview situations	▪ Group discussion	▪ Oral evaluation	1 hr.
		▪ Conduct interview ▪ Apply organizations procedure in maintaining records of interviews ▪ Use questioning, listening and nonverbal communication techniques to client groups	▪ Demonstration	▪ Observation	
2. Develop teams and individuals	2.1 Provide team leadership	▪ Describe o Coaching and mentoring principles o working effectively with team members who have diverse work styles, aspirations, cultures and perspective o facilitating team development and improvement	▪ Group discussion	▪ Oral evaluation	1 hr.
		▪ Read o methods for identifying and prioritizing personal development opportunities and options o methods and techniques for eliciting and interpreting feedback	• Lecture	• Written examination	
		▪ Apply communication skills in receiving feedback and reporting, maintaining effective relationships and conflict management	▪ Group discussion	▪ Oral evaluation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
		▪ Apply team leadership skills to support colleagues: o Planning skills o Coaching and mentoring skills o Reporting skills o Facilitation skills	▪ Group discussion	▪ Oral evaluation	
	2.2 Foster individual and organizational growth	▪ Describe Learning and development program goals and objectives ▪ Apply learning delivery methods in preparing learning and program goals and objectives	▪ Group discussion	▪ Oral evaluation	1 hr.
			▪ Demonstration	▪ Observation	
		▪ Identify and prioritize personal development opportunities and options for career paths and competency standards in the industry	• Lecture	• Written examination	
	2.3 Monitor and evaluate workplace learning	▪ Use feedback system to identify and implement future learning arrangements improvements ▪ Assess and record outcomes and performance of individuals/teams ▪ Negotiate learning plan modifications for learning efficiency and effectiveness ▪ Maintain records and reports of competency	▪ Demonstration	▪ Observation	1 hr.
	2.4 Develop team commitment and cooperation	▪ Use open communication processes to obtain and share information by team	▪ Demonstration	▪ Observation	1 hr.
		▪ Apply decisions making skills in team agreed roles and responsibilities			
		▪ Demonstrate mutual concern and camaraderie in the team			

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
	2.5 Facilitate accomplishment of organizational goals	▪ Describe team activities and communication processes ▪ Apply individual and joint responsibility with team members ▪ Prepare organizational goals in collaboration with team members	▪ Group discussion ▪ Demonstration	▪ Oral evaluation ▪ Observation	1 hr.
3. Apply problem solving techniques in the workplace (Critical thinking and problem solving techniques)	3.1 Analyze the problem *(Use system thinking)*	▪ Describe o organizational systems and functions o help desk and maintenance practices	▪ Group discussion	▪ Oral evaluation	2 hrs.
		▪ Read o hardware and software products o operating system o client business domain o industry practices on escalation procedures o diagnostic tools	• Lecture	• Written examination	
		▪ Video presentation on applying problem solving techniques in the workplace ▪ Apply in problem solving: o Decision making skills o Communication skills o Teamwork o Time management o General customer service skills o Questioning and active listening ▪ Gather data for evaluated Issues/concerns	• Video viewing ▪ Demonstration	• Oral evaluation ▪ Observation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
		▪ Use problem solving tools/analytical techniques to identify possible causes of problem	▪ Demonstration	▪ Observation	
	3.2 Identify possible solutions	▪ Apply possible options to consider in preparing: o Resolution of the problem o Strengths and weaknesses o Corrective action	▪ Demonstration	▪ Observation	1 hr.
	3.3 Recommend solution to higher management *(Make judgment and decisions/ Solve problems)*	▪ Prepare documentation to appropriate personnel: o communication or documentation Report o Recommendations ▪ Coordinate follow-up if required	▪ Demonstration	▪ Observation	1 hr.
	3.4 Implement solution	▪ Identify o Measurable objectives o Resource needs o Timelines	• Lecture	• Written examination	1 hr.
	3.5 Evaluate/ Monitor results and outcome	▪ Read evaluative assessment of problem ▪ Evaluate results and outcome of problem ▪ Prepare and submit recommendations to superiors	▪ Demonstration	▪ Observation	1 hr.

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
4. Collect, Analyze and Organize Information (access and evaluate information)	4.1 Study information requirements	▪ Describe o Data processing, Information analysis and interpretation ▪ Read o Research methods: – Qualitative – Quantitative – Statistical o Report writing o Use of relevant software – Spreadsheets – Presentation graphics – Work processor – Statistical package	▪ Group discussion • Lecture	▪ Oral evaluation • Written examination	1 hr.
		▪ Identify research procedures ▪ Use relevant forms and recording systems to gather information ▪ Conduct survey / research to selected respondents based on established procedures	• Lecture ▪ Demonstration	• Written examination ▪ Observation	
	4.2 Process data	▪ Use prescribed researched method in: o Collecting data o Referencing relevant data o Compiling information in required form	▪ Demonstration	▪ Observation	1 hr.

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
	4.3 Analyze, interpret and organize	▪ Prepare analysis of data using: o relevant methodologies o statistical analysis/methods o graphs and other visual presentations	▪ Demonstration	▪ Observation	1 hs.
	4.4 Present findings/ recommendations	▪ Gather inputs to finalize report ▪ Prepare draft report in standard format ▪ Prepare and package summary of findings ▪ Submit and disseminate technical report to concerned offices	▪ Demonstration	▪ Observation	1 hr.
5. Plan and organize work (manage projects)	5.1 Set objectives	▪ Describe Organization's strategic plan, policies rules and regulations, laws and objectives related to: o work unit activities and priorities o role of the work unit	▪ Group discussion	▪ Oral evaluation	1 hr.
		▪ Video presentation on planning and organizing work	• Video viewing	• Oral evaluation	
		▪ Prepare objectives consistent with work activities and according to organizational aims with: o measurable targets o realistic and attainable o support and commitment of team members	▪ Demonstration	▪ Observation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
	5.2 Plan and schedule work activities	▪ Identify and prioritize tasks/work as directed	• Lecture	• Written examination	1 hr.
		▪ Prepare tasking of activities with o Set time frames o Allocated Resources o Schedule of work activities of concerned personnel	▪ Demonstration	▪ Observation	
	5.3 Implement work plans	▪ Identify work methods and practices	• Lecture	• Written examination	2 hrs.
		▪ Implement work plans with set time frames, resources and standards	▪ Demonstration	▪ Observation	
	5.4 Monitor work activities	▪ Monitor: o work activities with set objectives o Work performance ▪ Use recommended format and reporting requirements in preparing report ▪ Prepare report and recommendations of deviations from work activities	▪ Demonstration	▪ Observation	1 hr.
	5.5 Review and evaluate work plans and activities	▪ Use accurate, relevant and current information in the review and implementation of work plans and strategies	▪ Demonstration	▪ Observation	1 hr.
		▪ Review outcomes of work plans and strategies in consultation to appropriate personnel ▪ Prepare adjustments/simplifications on policies, processes and activities on results of review provided by concerned parties			
		▪ Prepare Performance appraisal report as per organization requirements			

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
		▪ Prepare and present recommendations to appropriate personnel/authorities ▪ Implement feedback mechanisms in line with organization policies	▪ Demonstration	▪ Observation	
6. Promote environmental protection	6.1 Study guidelines for environmental concerns	▪ Describe o environmental legislations/conventions and local ordinances - International Environmental Protocols (Montreal, Kyoto) o Industrial standard/environmental practices - Sanitary Code - Environmental Code of practice	▪ Group discussion	▪ Oral evaluation	1 hr.
		▪ Read o Features of an environmental management strategy o Waste minimization hierarchy o Environmental planning/management	• Lecture	• Written examination	
		▪ Prepare environment research and analysis ▪ Apply: o 5S of Good Housekeeping o 3Rs – Reduce, Reuse & Recycle	▪ Demonstration	▪ Observation	
		▪ Video presentation on Environment	• Video viewing	• Oral evaluation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Method	Nominal Duration
	6.2 Implement specific environmental programs	▪ identify environmental programs/activities according to organizations policies and guidelines	• Lecture	• Written examination	2 hrs.
		▪ Perform individual roles/responsibilities based on the identified activities ▪ Apply problem solving skill in resolving encountered problems/constraints according to organizations policies and guidelines	▪ Demonstration ▪ Simulation/Role Play	▪ Observation	
		▪ Coordinate environmental programs/ activities with stakeholders based on company guidelines	▪ Demonstration	▪ Observation	
	6.3 Monitor activities on environmental protection/ programs	▪ Monitor activities on environmental protection/ programs	▪ Demonstration	▪ Observation	1 hr.
		▪ Follow management support system in sustaining and enhancing the program			
		▪ Prepare environmental incidents report and submit to concerned / proper authorities			
		▪ Gather feedback from stakeholders on proposed program enhancements	▪ Demonstration	▪ Observation	
		▪ Evaluate and analyze findings for the enhanced program according to: o gathered data o submitted recommendations			

COMMON COMPETENCIES
64 hrs

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
1. Use Hand Tools	1.1 Plan and prepare for tasks to be undertaken	▪ Plan and prepare for task/activity ▪ Identify different types and functions of hand tools ▪ Identify electronics hand tools and their uses ▪ Identify function, operation and common faults in electronics hand tools	▪ Lecture / Demonstration ▪ Group discussion	▪ Written/Oral examination	2 hours
	1.2 Prepare hand tools	▪ Practice proper use of hand tools ▪ Practice checking and safety requirements in handling tools ▪ Apply standard procedures in checking, identification and marking of safe or unsafe/ faulty tools ▪ Perform marking of safe or unsafe/ faulty hand tools	▪ Lecture / Demonstration ▪ Role play ▪ Video presentation	▪ Written/Oral examination ▪ Practical demonstration	2 hours
	1.3 Use appropriate hand tools and test equipment.	▪ Apply safety handling of hand tools and test equipment ▪ Identify/Select electronics hand tools for adjusting, dismantling, assembling, finishing, and cutting ▪ Use appropriate hand tools and test equipment for the job requirement ▪ Read and learn the - o Proper usage and care of hand tools o Types and uses of test equipment ▪ Identify common faults in the use of hand tools	▪ Lecture / Demonstration ▪ Role play ▪ Video presentation	▪ Written/Oral examination ▪ Practical demonstration	2 hours
	1.4 Maintain hand tools	▪ Apply safety requirements in maintenance of hand tools ▪ Read and understand processes, operations & systems for: o Maintenance of tools o Storage of hand tools ▪ Apply 5S principles in maintenance of hand tools	▪ Lecture / Demonstration ▪ Group discussion	▪ Written/Oral examination ▪ Practical demonstration	2 hours
2. Perform Mensurations and Calculation	2.1 Select measuring instruments;	▪ Identify category and types of measuring tools and its uses ▪ Select measuring instruments as per category ▪ Interpret shapes and dimensions of objects/components	▪ Lecture ▪ Group discussion	▪ Written examination ▪ Oral evaluation	2 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	2.2 Carry-out measurements and calculations	▪ Read a. Measurements - Linear measurement - Geometrical measurement b. Trade Mathematics - Unit conversion - Ratio and proportion - Area ▪ Interpret formulas for volume, areas, perimeters of plane and geometric figures ▪ Perform measurement ▪ Compute measurement formulas	▪ Lecture ▪ Group discussion ▪ Problem analysis	▪ Written examination ▪ Oral evaluation ▪ Problem solving	4 hours
	2.3 Maintain measuring instruments	▪ Identify and practice safe handling procedures in using measuring instruments ▪ Describe procedures on maintenance of measuring instruments ▪ Demonstrate proper cleaning and storage of measuring instruments	▪ Lecture ▪ Demonstration ▪ Group discussion ▪ Simulation	▪ Written examination ▪ Oral evaluation	2 hours
3. Prepare and Interpret Technical Drawing	3.1 Identify different kinds of technical drawings	▪ Read o Types of technical drawings o Technical drawing applications o Mark up/Notation of Drawings ▪ Identify type of drawing ▪ Evaluate mark-up/ notation of drawings ▪ Interpret signs and symbols	▪ Lecture ▪ Demonstration ▪ Group discussion ▪ Simulation	▪ Written examination ▪ Oral evaluation	2 hours
	3.2 Interpret technical drawing	▪ Interpret blueprint reading and plan specification - Electronics symbols and abbreviations - Drawing standard symbols ▪ Read: a. Trade Theory - Types of electronics/ semiconductors product plans - Notes and specifications	▪ Lecture ▪ Demonstration ▪ Group discussion ▪ Basic technical drafting activity	▪ Written examination ▪ Oral evaluation ▪ Drafting technical drawings and plans	2 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		b. Trade mathematics - Linear measurement - Dimension - Unit convention ▪ Match specification details with existing resources			
	3.3 Prepare/ make changes to electrical/ electronic schematics and drawings	▪ Read - Freehand sketching techniques - Pictorial drawing - Drawing conventions - Dimensioning conventions ▪ Apply mathematics - Four fundamental operations - Percentage - Fraction - Algebra - Geometry ▪ Sketch drawings and plans ▪ Sketch pictures ▪ Compute formulas ▪ Use drawing instruments	▪ Lecture ▪ Demonstration ▪ Group discussion ▪ Basic technical drafting activity	▪ Written examination ▪ Oral evaluation ▪ Drafting technical drawings and plans	2 hours
	3.4 Store technical drawings and equipment/ instruments	▪ Identify effective ways to catalogue and store technical drawings ▪ Identify manual methods of handling, storing and maintaining paper drawings ▪ Read and demonstrate - Storing drawing in digital forms, i.e. Scanner, CAD - Handling and storing of drawings - Handling and storing drawing instruments	▪ Lecture ▪ Demonstration ▪ Group discussion ▪ Simulation	▪ Written examination ▪ Oral evaluation	2 hours
4. Apply Quality Standards	4.1 Assess quality of received materials	▪ Identify relevant production processes, materials and products ▪ Study and interpret characteristics of materials, software and hardware used in production processes ▪ Perform quality checking procedures ▪ Apply quality Workplace procedures	▪ Lecture ▪ Field trip ▪ Symposium ▪ Video clips ▪ Simulation/ Role playing	▪ Written test ▪ Demonstration & questioning ▪ Observation & questioning	3 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		▪ Identify faulty materials ▪ Check quality of materials or component parts as per manufacturer's standards ▪ Interpret specifications or symbols			
	4.2 Assess own work	▪ Perform workplace procedure in documenting completed work ▪ Perform fault identification and reporting ▪ Observe safety and environmental aspects of production processes ▪ Utilize workplace quality indicators ▪ Document and report deviations from specified quality standards	▪ Field trip ▪ Symposium ▪ Simulation ▪ On the job training	▪ Demonstration & questioning ▪ Observation & questioning	3 hours
	4.3 Engage in quality improvement	▪ Participate in quality improvement processes a. IEC/ISO standards b. Environmental and safety standards ▪ Carry out work as per process improvement procedures ▪ Monitor operation performance ▪ Implement continuous improvement	▪ Field trip ▪ Symposium ▪ Simulation ▪ On the job training	▪ Demonstration & questioning ▪ Observation & questioning	2 hours
5. Perform Computer Operations	5.1 Plan and prepare for task to be undertaken	▪ Plan and prepare computer operation activity ▪ Determine task requirements based on required output ▪ Determine appropriate hardware and software ▪ Identify/Select types of computers and basic features of different operating systems ▪ Interpret and follow client-specific guidelines & procedures ▪ Plan task as per data security guidelines	▪ Lecture ▪ Modular ▪ Computer based training (e-learning) ▪ Project method ▪ On the job training	▪ Written/Oral examination ▪ Practical demonstration	2 hours
	5.2 Input data into computer	▪ Apply basic ergonomics of keyboard and computer user ▪ Enter/Encode data using appropriate computer programs/applications ▪ Check accuracy of encoded data/information per SOP ▪ Save and store inputted data in storage media ▪ Storage devices and basic categories of memory ▪ Identify and define relevant types of software	▪ Lecture ▪ Modular ▪ Group discussion ▪ Project method ▪ On the job training	▪ Written/Oral examination ▪ Practical demonstration	1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

	5.3 Access information using computer	▪ Select correct program/ application based on job requirements
		▪ Access computer data/files
		▪ Interpret general security, privacy legislation & copyright
		▪ Use Productivity Application
		  ▪ Microsoft office applications
		▪ Learn Business Application
		  ▪ Introduction to Basic Programming software
		▪ Apply basic ergonomics of keyboard and computer user
			▪ Lecture
			▪ Computer based training (e-learning)
			▪ On the job training
				▪ Written/Oral examination
				▪ Practical demonstration
					2 hours

	5.4 Produce/output data using computer system	▪ Identify types and function of computer peripheral devices
		▪ Print and scan office documents and materials
		▪ Send office/ business documents through facsimile
		▪ Transfer files or data between compatible systems using computer software, hardware/ peripheral devices
		▪ Save documents in storage devices
		  a. CD/DVD
		  b. USB drives
		  c. Hard disk drives
			▪ Lecture
			▪ Group discussion
			▪ Modular
			▪ On the job training
				▪ Written/Oral examination
				▪ Practical demonstration
					1 hour

	5.5 Maintain computer equipment and systems	▪ Perform computer equipment/ system basic maintenance procedures
		  a. Perform basic file maintenance procedures
		  b. Perform cleaning of PC parts/ hardware components
		  c. Scan/Debug computer software and applications
		  d. Perform cleaning and defragmentation of computer files
		  e. Perform backup of computer files
		▪ Enumerate and define different types of computer viruses
			▪ Demonstration
			▪ Simulation
			▪ Modular
			▪ Video clips
			▪ Computer based training (e-learning)
				▪ Written/Oral examination
				▪ Practical demonstration
					2 hours

6. Terminate and Connect Electrical wiring and Electronic Circuit	6.1 Plan and prepare for termination/ connection of electrical wiring/ electronics circuits	▪ Enumerate uses of hand tools and test instruments / equipment
		▪ Read :
		  ○ Basic Electrical theory and application
		  ○ Basic electrical and electronic devices
		  ○ OH & S guidelines and procedures
		▪ Prepare hand tools and test equipment for termination
		▪ Prepare electrical/electronic materials for termination
			▪ Lecture/ Discussion
			▪ Individualized Learning
			▪ Direct Student Laboratory Experience
				▪ Written/Oral examination
				▪ Practical demonstration
					1 hour

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	6.2 Terminate/ connect electrical wirings/ electronic circuits	▪ Read: • Electrical wirings o Wiring techniques o OH & S principles o Specifications and methods for terminating different materials • Electronics circuits o Soldering techniques and procedures o OH & S principles o Surface mount soldering techniques o Use of lead-free soldering technology ▪ Perform different types of splices ▪ Perform soldering techniques and procedures	▪ Lecture/ Discussion ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ Project Method	▪ Written/Oral examination ▪ Practical demonstration	4 hours
	6.3 Test termination/ connections of electrical wiring/ electronics circuits	▪ Use diagnostic equipment ▪ Perform continuity testing and grounding o Electrical o Electronics ▪ Perform functionality test o Electrical o Electronics	▪ Lecture/ Discussion ▪ Film Viewing ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ Project Method	▪ Written/Oral examination ▪ Practical demonstration	3 hours
7. Test electronic components	7.1 Determine criteria for testing electronics components	▪ Identify work safety requirements and economy of materials with durability ▪ Determine testing criteria for electronics components controls o effectiveness o efficiency o bug detection o functionality, including flow o interoperability o performance o reliability o operating parameters	▪ Film Viewing ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ On the Job Training ▪ Project Method	▪ Written/Oral examination ▪ Practical demonstration	2 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	7.2 Plan an approach for component testing	▪ Determine 5S application and observation of required timeframe ▪ Identify work safety requirements and economy of materials with durability ▪ Evaluate various testing methods ▪ Identify types of electronic components ▪ Practice proper use of VOM/DMM ▪ Observe OH&S principles ▪ Identify testing methods	▪ Lecture/ Discussion ▪ Individualized Learning ▪ Direct Student Laboratory Experience	▪ Written/Oral examination ▪ Practical demonstration	2 hours
	7.3 Test components	▪ Read • Materials, tools and equipment uses and specifications • Proper care and use of tools ▪ Identify types of electronic components • Passive components • Active components • Dynamic components • Hybrid components ▪ Determine testing methods • automated • debugging • inspection • platform testing • prototyping ▪ Measure capacitance and resistance using VOM/ DMM ▪ Determine testing procedures for electronics components ▪ Apply proper use of testing instruments	▪ Lecture/ Discussion ▪ Individualized Learning ▪ Direct Student Laboratory Experience	▪ Written/Oral examination ▪ Practical demonstration	8 hours
	7.4 Evaluate the testing process	▪ Determine testing process and records system ▪ Analyze different systems and processes • Analyzing simple circuit using ohms and power law • Analyzing series/ parallel circuits using ohms and power law • Analyzing series/ parallel capacitances • analyzing series parallel inductors	▪ Film Viewing ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ On the Job	▪ Demonstration and Questioning ▪ Assessment of Output Product	4 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		• analyzing rectifier circuits • analyzing amplifier circuit • analyzing multi-vibrator circuit • analyzing logic networks • analyzing sequence circuits ▪ Perform data evaluation and records ▪ Evaluate functionality and operation of electronic system	Training ▪ Project Method		

CORE COMPETENCIES

106 hrs

Note: *This course design covers only Mechatronics Servicing NC level IV core units. The trainee attending this course must have completed first both the units for Mechatronics Servicing NC II and NC III.*

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

1. Develop advanced PLC and HMI application program	1.1 Prepare advanced PLC and HMI application program.	• Read and familiarize
		  ○ Advanced PLC application program
		  ▪ Program organization
		  ▪ Data types
		  ▪ Variables
		  ▪ Configuration
		  ○ HMI application program
		  ▪ HMI layout
		  ▪ Screen development
		  ▪ Drawing tools
		  ▪ Advanced PLC and HMI interfacing
		  ▪ Basic HMI tools
		  ○ Advanced PLC and HMI analog program instructions
		  ○ Advanced PLC and HMI Communication setup and networking
		  ○ Advanced PLC program instructions
		  ▪ Relay
		  ▪ Timer Counter
		  ▪ Math instructions
		  ▪ Data manipulation
		  ▪ Program control
		  ○ PLC program debugging techniques
		• Configure PLC to Human Machine Interface (HMI) hardware
		• Configure HMI to programming device and PLC
		• Perform tagging of PLC inputs and outputs to HMI display and monitoring functionality
		• Download programs and display functionality to the PLC and HMI
			• Lecture
			• Discussion
			• Viewing multimedia
				• Written exam
				• Interviews/ questioning
					16 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	1.2 Test developed PLC and HMI software application program	• Read and familiarize advanced PLC and HMI communication and configuration protocol • Downloading and uploading procedures of advanced PLC and HMI application program • Testing and commissioning procedures for advanced PLC and HMI application program • Interfacing configuration, specifically PLC, PC and HMI • Identifying warnings and errors on your programs and HMI software and its level of priority. • Distinguishing the different modes of operation of PLC and HMI • Applying comments and tags on software programs	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Interviews/ questioning	16 hours
	1.3 Document advanced PLC and HMI application program developed.	• Computer software applications o Computer Aided Design (CAD) o Microsoft office application • Exporting advanced PLC and HMI software program • Compilation of softcopy and printed formats • Saving and converting developed application programs • Creating a security or password on your program (optional) • Printing the whole program or part of the program	• Lecture • Discussion • Viewing multimedia	• Written exam • Practical exam • Interviews/ questioning	4 hours
2. Commission advanced PLC- and HMI-based mechatronics and automation systems	2.1 Plan and prepare to undertake commissioning process	• Read and familiarize o Use of tools and test equipment/ instrument ▪ Multitester ▪ Laptop / PC ▪ PLC programmer/ software ▪ Human Machine Interface (HMI) ▪ PLC o Sequence diagram of the PLC/ HMI system o Field and control devices o Occupational health and safety o PLC and HMI I/O checking o Communication/ Interface cables • Interpreting schematic diagrams and its final wiring	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	8 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		connections. • Familiarize the techniques and procedures in choosing the applicable controller and system.			
	2.2 Commission mechatronics and automation systems	• Familiarize and apply PPE and OHS policies and procedures • Learn different control circuits connections o Electro-mechanical o Pneumatic & electro-pneumatic o Electro-hydraulic o Electrical/ Electronic components • Learn different motion control systems • Applying PPE and OHS policies and procedures • Performing commissioning activities o Electro-mechanical o Pneumatic & electro-pneumatic o Electro-hydraulic o Electrical/ Electronic components	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	16 hours
	2.3 Document commissioned mechatronics and automation systems	• Make documentation of commissioned mechatronics and automation system • Learn different types of technical reports o Pre-commissioning report o Compliance output report • Perform verification of final system • Perform setup based on design & expected output and performance • Preparing a User Acceptance Test (UAT) and Site Acceptance Test (SAT) report • Draft print out of as-built document o Diagrams - Electrical/ electronics - Electro-mechanical - Pneumatic/ electro-pneumatics - Hydraulic / electro-hydraulics o PLC and HMI layout o Application programs	• Lecture • Discussion • Viewing multimedia	• Written exam • Interviews/ questioning	4 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration

3. Diagnose and troubleshoot advanced PLC- and HMI-based mechatronics and automation systems	3.1 Plan and prepare for diagnosis of faults in mechatronics and automation systems	• Planning and preparing diagnosis of faults
		• Equivalent replacement of parts and equipment
		• Diagnostic and troubleshooting procedures for mechatronics and automation equipment
		• Identification of diagnostic materials
		  ○ Wires
		  ○ Terminal lugs
		  ○ Terminal Blocks
		  ○ Wire Marker
		• Familiarize advanced PLC and HMI mechatronics and automation system
		  ○ Sensors and transducer elements
		  ○ Electro-mechanical elements
		  ○ Pneumatic & electro-pneumatic elements
		  ○ Hydraulic elements
		  ○ Actuators & output devices
		• Categorizing fault analysis on PLC and HMI configure system.
		• Identifying replacement parts and equipment
		• Identifying diagnostic materials
		  ○ Wires
		  ○ Terminal lugs
		  ○ Terminal Blocks
		  ○ Wire Marker
		  ○ Sensors and transducer elements
			• Lecture
			• Discussion
			• Viewing multimedia
				• Written exam
				• Practical exam
				• Interviews/ questioning
					8 hours

	3.2 Diagnose faults of mechatronics and automation systems	• Learn common problems and faults of mechatronics and automation systems
		• Identify fault finding techniques
		• Perform visual inspection techniques
		• Apply out-of-control action plan (OCAP) on unplanned events or conditions
		• Enumerating fault analysis techniques on different mechatronics and automation devices
		  ○ Electrical
		  ○ Pneumatic/ electro-pneumatic
			• Lecture
			• Discussion
			• Demonstration
			• Viewing multimedia
				• Written exam
				• Practical exam Observation in workplace
				• Interviews/ questioning
					10 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
		○ Hydraulic/ electro-hydraulic • Classifying different maintenance technique and procedure in faults diagnosis.			
	3.3 Rectify/correct faults in the mechatronics and automation system	• Read and familiarize ○ Product replacement and specifications in mechatronics and automation system ○ Equipment isolation technique and procedures ○ Contingency procedures on unplanned events or conditions at fault correction and rectification • Performing corrective maintenance techniques on identified faults and errors on advanced PLC and HMI based mechatronics and automation system • Performing corrective maintenance techniques on identified faults and errors on mechatronics and automation equipment	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam Observation in workplace • Interviews/ questioning	16 hours
	3.4 Test the corrected mechatronics system	• Apply advanced PLC and HMI mechatronics and automation systems operation testing procedures • Draft technical reports especially testing and commissioning report • Evaluating the pre-maintenance and post-maintenance results or outcome. • Distinguishing the final output or outcome of the final stage or station of the system	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam Observation in workplace • Interviews/ questioning	8 hours

3.2 TRAINING DELIVERY

1. The delivery of training shall adhere to the design of the curriculum. Delivery shall be guided by the principles of competency-based TVET.

    a. Course design is based on competency standards set by the industry or recognized industry sector; **(Learning system is driven by competencies written to industry standards)**

    b. Training delivery is learner-centered and should accommodate individualized and self-paced learning strategies;

    c. Training can be done on an actual workplace setting, simulation of a workplace and/or through adoption of modern technology.

    d. Assessment is based in the collection of evidence of the performance of work to the industry required standards;

    e. Assessment of competency takes the trainee's knowledge and attitude into account but requires evidence of actual performance of the competency as the primary source of evidence.

    f. Training program allows for recognition of prior learning (RPL) or current competencies;

    g. Training completion is based on satisfactory performance of all specified competencies.

2. The competency-based TVET system recognizes various types of delivery modes, both on-and off-the-job as long as the learning is driven by the competency standards specified by the industry. The following training modalities and their variations/components may be adopted singly or in combination with other modalities when designing and delivering training programs:

2.1. Institution- Based:

- **Dual Training System (DTS)/Dualized Training Program (DTP)** which contain both in-school and in-industry training or fieldwork components. Details can be referred to the Implementing Rules and Regulations of the DTS Law and the TESDA Guidelines on the DTP;
- The **traditional classroom-based or in-center instruction** may be enhanced through use of learner-centered methods as well as laboratory or field-work components.

2.2 Enterprise-Based:

- **Formal Apprenticeship** – Training within employment involving a contract between an apprentice and an enterprise on an approved apprenticeable occupation.
- **Enterprise-based Training-** where training is implemented within the company in accordance with the requirements of the specific company. Specific guidelines on this mode shall be issued by the TESDA Secretariat.

3.3 TRAINEE ENTRY REQUIREMENTS

The trainees who wish to enter the course should possess the following requirements:

- Holder of Mechatronics Servicing NC III

This list does not include specific institutional requirements such as educational attainment, appropriate work experience, and others that may be required of the trainees by the school or training center delivering the TVET program.

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS

Recommended list of tools, equipment and materials for the training of 25 trainees for Mechatronics Servicing NC IV:

TOOLS		EQUIPMENT		MATERIAL	
Qty.	Description	Qty.	Description	Qty.	Description
10 pcs	Long-nosed pliers	5 sets	PLC system	1 spool	Solder lead
10 pcs	Standard screwdrivers	5 sets	PLC configuration software	1 spool	Shielded cable
10 pcs	Diagonal cutters	10 pcs	Multimeters	1 lot	Terminal lugs
10 pcs	Phillips screwdrivers	5 pcs	Regulated power supplies	1 lot	Terminal strips/blocks
10 pcs	Electrical pliers	4 sets	HMI panel	10 pcs	Cotton gloves
10 pcs	Soldering iron	4 sets	HMI software	1 lot	Plastic tubing
5 sets	Precision screwdrivers	2 pcs	Transmitters or Transducers	1 lot	Quick-connect fittings
10 pcs	Adjustable wrench	1 pc.	Air compressor	10 rolls	Electrical tape
5 pcs	Wire stripper	2 pcs	Signal generators	1 lot	Wire markers
5 pcs	Crimping tool	20 pcs	Cylinder Actuator	1 lot	Cable ties
5 sets	Allen wrench	1 pc.	Stepper motor		
		2 pc.	Variable frequency drive		
		1 pc.	Servomotor		
		10 pcs	Buzzers		
		25 pcs	Industrial panel switches		
		10 pcs	Indicating lamps		
		10 pcs	Directional solenoid valves		
		5 pcs	Filter-Regulator-Lubricator set		
		5 pcs	Pressure gage		
		5 pcs	Limit switches		

TOOLS		EQUIPMENT		MATERIAL	
Qty.	Description	Qty.	Description	Qty.	Description
		5 pcs	Photoelectric switches		
		5 pcs	Proximity switches		
		25 pcs	Relays		
		10 pcs	Magnetic contactors		
		5 pc.	Desktop/Laptop PC		
		5 pc.	Safety helmet		
		5 pc.	Safety shoes		
		5 pc.	Safety harness		
		5 pc.	Safety glasses/ goggles		
		5 pc.	Ear plugs/ear muffs		
		5 pcs	Gas mask		

3.5 TRAINING FACILITIES

Based on class size of 25 students/trainees the space requirements for the teaching/learning and circulation areas are as follows:

TEACHING/LEARNING AREAS	SIZE IN METERS	AREA IN SQ. METERS	QTY	TOTAL AREA IN SQ. METERS
Lecture Area	5 x 8	40	1	40
Laboratory Area	5 x 8	40	1	40
Learning Resource Area	4 x 5	20	1	20
Tool Room / Storage Area	4 x 5	20	1	20
Wash ,Toilet & Locker Room	1 x 2	2	1	2
Total				122
Facilities / Equipment / Circulation**				36
Total Area				**158**

***** Area requirement is equivalent to 30% of the total teaching/learning areas***

3.6 TRAINERS QUALIFICATIONS

Mechatronics Servicing NC IV

- Must be a holder of National TVET Trainer's Certificate (NTTC) Level I in Mechatronics Servicing NC IV
- Must have at least 4-years relevant industry experience

3.7 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their achievement of units of competency. A certificate of achievement is issued for each unit of competency.

The result of the institutional assessment may be considered as evidence for the assessment for national certification.

SECTION 4. ASSESSMENT AND CERTIFICATION ARRANGEMENTS

Competency Assessment is the process of collecting evidence and making judgments whether competency has been achieved. The purpose of assessment is to confirm that an individual can perform to the standards expected at the workplace as expressed in relevant competency standards.

The assessment process is based on evidence or information gathered to prove achievement of competencies. The process may be applied to an employable unit(s) of competency in partial fulfillment of the requirements of the national qualification.

4.1. NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1.1. To attain the National Qualification of **Mechatronics Servicing NC IV**, the candidate must demonstrate competence in all the units listed in Section 1. Successful candidates shall be awarded a **National Certificate IV** signed by the TESDA Director General.

4.1.2. The qualification of **Mechatronics Servicing NC IV** can be attained through demonstration of competence through project-type assessment covering all the units of competency required in the qualification.

4.1.3. Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

4.1.4. The following are qualified to apply for assessment and certification:

4.1.4.1. Graduate of formal and non-formal including enterprise-based training programs.
4.1.4.2. Experienced workers (wage employed or self-employed)

4.1.5. Existing National Certificate (NC) and Certificate of Competency (COC) of individuals in Mechatronics Servicing NC IV will still be in effect until such time that such NC and COC will have expired. Individuals are advised to take the assessment for this amended TR on or before the expiration of such certificates.

4.1.6. The guidelines on assessment and certification are discussed in detail in the “Procedures Manual on Assessment and Certification” and “Guidelines on the Implementation of the Philippine TVET Competency Assessment and Certification System (PTCACS)”.

4.2. COMPETENCY ASSESSMENT REQUISITE

4.2.1 *Self-Assessment Guide*. The self-assessment guide (SAG) is accomplished by the candidate prior to actual competency assessment. SAG is a pre-assessment tool to help the candidate and the assessor determine what evidence is available, where gaps exist, including readiness for assessment.

This document can:

a. Identify the candidate's skills and knowledge
b. Highlight gaps in candidate's skills and knowledge
c. Provide critical guidance to the assessor and candidate on the evidence that need to be presented
d. Assist the candidate to identify key areas in which practice is needed or additional information or skills that should be gained prior`

4.2.2 *Accredited Assessment Center*. Only Assessment Center accredited by TESDA is authorized to conduct competency assessment. Assessment centers undergo a quality assured procedure for accreditation before they are authorized by TESDA to manage the assessment for National Certification.

4.2.3 *Accredited Competency Assessor*. Only accredited competency assessor is authorized to conduct assessment of competence. Competency assessors undergo a quality assured system of accreditation procedure before they are authorized by TESDA to assess the competencies of candidates for National Certification.

DEFINITION OF TERMS

GENERAL

1) **Certification -** is the process of verifying and validating the competencies of a person through assessment

2) **Certificate of Competency (COC)** – is a certification issued to individuals who pass the assessment for a single unit or cluster of units of competency

3) **Common Competencies** - are the skills and knowledge needed by all people working in a particular industry

4) **Competency** - is the possession and application of knowledge, skills and attitudes to perform work activities to the standard expected in the workplace

5) **Competency Assessment -** is the process of collecting evidence and making judgments on whether competency has been achieved

6) **Competency Standard (CS)** - is the industry-determined specification of competencies required for effective work performance

7) **Context of Assessment** - refers to the place where assessment is to be conducted or carried out

8) **Core Competencies -** are the specific skills and knowledge needed in a particular area of work - industry sector/occupation/job role

9) **Critical aspects of competency -** refers to the evidence that is essential for successful performance of the unit of competency

10) **Elective Competencies -** are the additional skills and knowledge required by the individual or enterprise for work

11) **Elements** - are the building blocks of a unit of competency. They describe in outcome terms the functions that a person perform in the workplace.

12) **Evidence Guide** - is a component of the unit of competency that defines or identifies the evidences required to determine the competence of the individual. It provides information on critical aspects of competency, underpinning knowledge, underpinning skills, resource implications, assessment method and context of assessment

13) **Level -** refers to the category of skills and knowledge required to do a job

14) **Method of Assessment** - refers to the ways of collecting evidence and when, evidence should be collected

15) **National Certificate (NC)** – is a certification issued to individuals who achieve all the required units of competency for a national qualification defined under the Training Regulations. NCs are aligned to specific levels within the PTQF

16) **Performance Criteria** - are evaluative statements that specify what is to be assessed and the required level of performance

17) **Qualification** - is a cluster of units of competencies that meets job roles and are significant in the workplace. It is also a certification awarded to a person on successful completion of a course in recognition of having demonstrated competencies in an industry sector

18) **Range of Variables** - describes the circumstances or context in which the work is to be performed

19) **Recognition of Prior Learning (RPL)** – is the acknowledgement of an individual's skills, knowledge and attitudes gained from life and work experiences outside registered training programs

20) **Resource Implications -** refers to the resources needed for the successful performance of the work activity described in the unit of competency. It includes work environment and conditions, materials, tools and equipment

21) **Basic Competencies -** are the skills and knowledge that everyone needs for work

22) **Training Regulations (TR)** – refers to the document promulgated and issued by TESDA consisting of competency standards, national qualifications and training guidelines for specific sectors/occupations. The TR serve as basis for establishment of qualification and certification under the PTQF. It also serves as guide for development of competency-based curricula and instructional materials including registration of TVET programs offered by TVET providers

23) **Underpinning Knowledge -** refers to the competency that involves in applying knowledge to perform work activities. It includes specific knowledge that is essential to the performance of the competency

24) **Underpinning Skills** - refers to the list of the skills needed to achieve the elements and performance criteria in the unit of competency. It includes generic and industry specific skills

25) **Unit of Competency** – is a component of the competency standards stating a specific key function or role in a particular job or occupation; it is the smallest component of achievement that can be assessed and certified under the PTQF

SECTOR SPECIFIC

1) **Actuator:** In a closed-loop control system, that part of the final control element that translates the control signal into action by the control device.

2) **Automation**: (1) The conversion to and implementation of procedures, processes, or equipment by automated means. (2) Industrial open- or closed-loop control systems in which the manual operation of controls is replaced by servo operation.

3) **CAD**: Computer-Aided Design is the use of high-resolution graphics in a wide range of design activities, allowing quick evaluation and modification of intent. It is commonly used to design architectural, mechanical and electrical engineering drawings.

4) **Conveyor:** A horizontal, inclined or vertical device for moving or transporting bulk materials, packages, or objects in a path predetermined by the design of the device and having points of loading and discharge fixed, or selective.

5) **Ergonomics** --"The systematic application of knowledge about the psychological, physical, and social attributes of human beings in the design and use of all things which affect a person's working conditions: equipment and machinery, the work environment and layout, the job itself, training and the organization of work." (Humansystems Inc).

6) **PLC (Programmable Logic Controller)** : A class of industrially hardened devices that provides hardware interface for input sensors and output actuators. PLCs can be programmed using relay ladder logic to control the outputs based on input conditions and / or algorithms contained in the memory of the PLC.

7) **Robotics**: The study of the design and use of robots, particularly for their use in manufacturing and related processes.

8) **Sensor:** A transducer whose input is a physical phenomenon and whose output is a quantitative measure of the phenomenon.

9) **Sequence control:** The control of a series of machine movements, with the completion of one movement initiating the next. The extent of movements is typically not specified by numerical input data.

10) **Servomechanism**: An automatic device for controlling large amounts of power by means of small amounts of power.

11) **Servomotor**: A power-driven mechanism that supplements a primary control operated by a comparatively feeble force (as in a servomechanism).

12) **Simulation**: (1) A device, system, or computer program that represents certain features of the behavior of a physical or abstract system. Vendors of planning and scheduling, forecasting and demand management, and other types of decision-support systems make growing use of simulation to compare the consequences of alternative courses of action.

13) **Software**: The entire set of programs, procedures, and related documentation associated with a computer.

14) **Static Calibration:** A calibration recording pressure versus output at fixed points at room temperature.

15) **Systems integration**: The ability of computers, instrumentation, and equipment to share data or applications with other components in the same or other functional areas.

ANNEX A - COMPETENCY MAP *(Electrical & Electronics sector)*

BASIC COMPETENCIES

Receive and Respond to Workplace Communication	Work with Others	Demonstrate work values	Practice basic housekeeping procedures	Participate in Workplace Communication
Work in a Team Environment	Practice career professionalism	Practice occupational health and safety procedures	Lead Workplace Communication	Lead Small Team
Develop and practice negotiation skills	Solve Problems Related to Work Activities	Use mathematical concepts and techniques	Use relevant technologies	**Utilize Specialist Communication Skills**
Develop Team and Individuals	**Apply Problem Solving Techniques in the Workplace**	**Collect, analyze and organize information**	**Plan and Organize Work**	**Promote environmental protection**

COMMON COMPETENCIES

Use Hand Tools	**Perform Mensuration and Calculation**	**Prepare and Interpret Technical Drawing**	**Apply Quality Standards**	**Perform Computer Operations**
Terminate and Connect Electrical Wiring and Electronic Circuits	**Test Electronic components**			

CORE COMPETENCIES

Install Instrumentation and Control Devices	Calibrate Instrumentation and Control Devices	Configure Instrumentation and Control Devices	Loop Check Instrumentation and Control Devices	Maintain and Repair Instrumentation & Control Devices
Start-up Instrumentation and Control Systems	Diagnose and Troubleshoot Instrumentation and Control Systems	Install Mechatronics and Automation Devices	Configure & Test Mechatronics and Automation System	Maintain and Repair PLC-based Mechatronics and Automation System
Develop Advanced PLC and HMI Software Application Program	**Diagnose and Troubleshoot Advanced PLC- and HMI-based Mechatronics and Automation Systems**	**Commission Advanced PLC- and HMI-based Mechatronics and Automation Systems**	Develop Mechatronics and Automation Control Circuits & PLC Software Application Programs	Develop Motion Control and System Configuration
Service and Repair Audio Systems and Products	Service and Repair Video Systems and Products	Service and Repair Business Machines	Assemble and Disassemble Consumer Electronic Products	Maintain and Repair Electronically Controlled Domestic Appliances
Maintain and Repair Audio-Video Products and Systems	Maintain and Repair Cellular Phones	Commission Consumer Electronic Products and Systems	Develop Servicing Systems for Consumer Electronic Products	Train service technician
Manage Servicing Systems for Consumer Electronics Products and Systems	Train service technician supervisors			

ACKNOWLEDGEMENTS

The Technical Education and Skills Development Authority (TESDA) wishes to extend gratitude and appreciation to the many representatives of business, industry, academe and government agencies and labor groups who donated their time and expertise to the development and validation of these Training Regulations.

- **THE TECHNICAL EXPERT COMMITTEE (FOR CY 2006)**

MR. ERNIE O. DIMALANTA
President, PICS Foundation, Inc.
President, PhilAsia School of Instrumentation and Automation

ENGR. CHUCK L.G. EBALO
VP-Academic Affairs, PhilAsia School Of Instrumentation and Automation

MS. MA. ZENAIDA S. VILLALVA
Professor, Rizal Technological University
Treasurer, PICS Foundation, Inc.

ENGR. RAINNEL R. MACLANG
Engineering Service Manager
Instrumentation & Control Specialist, Inc.

- **PHILIPPINE INSTRUMENTATION AND CONTROL SOCIETY FOUNDATION, INC.**

- **THE TESDA BOARD - STANDARDS SETTING AND SYSTEMS DEVELOPMENT COMMITTEE**

- **THE MANAGEMENT AND STAFF OF TESDA SECRETARIAT**

    - Qualifications and Standards Office (QSO)

ACKNOWLEDGEMENTS

The Technical Education and Skills Development Authority (TESDA) wishes to extend gratitude and appreciation to the many representatives of business, industry, academe and government agencies and labor groups who donated their time and expertise to the review, updating and validation of this Training Regulations.

- **THE REVIEW PANEL COMMITTEE (FOR CY 2015)**

1. GAMALIEL F. ITAO, PEE — MRSP/ICC
2. JOEL B. BAJADOR, PECE — IECEP/MRSP
3. PHILIP MARVIN D. JOVEN — ICC
4. THOMMY A. PURISIMA — MTC

- **THE VALIDATION EXPERT COMMITTEE**

1. AUGUSTO C. SOLIMAN, PME — Hytec Power, Inc.
2. EDWIN J. CALILUNG, PhD — DLSU
3. RODRIGOT. PECOLERA, PEE — IIEE / RT Pecolera Construction Corp.
4. ARIEL P. DURAN, REE, MBA — SPECS/ Polyphase One Construction, Inc.
5. SANDINO E. SERVIÑO — Bosco Tech/MTC
6. FRANK QUIACHON — MRSP
7. EDWIN A. STA. MARIA, PECE — Comp Intelems Integrated, Inc.

- **MECHATRONICS AND ROBOTICS SOCIETY OF THE PHILIPPINES**

- **THE TESDA BOARD - STANDARDS SETTING AND SYSTEMS DEVELOPMENT COMMITTEE**

- **THE MANAGEMENT AND STAFF OF TESDA SECRETARIAT**

  - Qualifications and Standards Office (QSO)

    1. MR. ZOILO C. GALANG - CSDD-QSO-TESDA
    2. MR. JULFORD C. ABASOLO - CSDD-QSO-TESDA
    3. MR. SAMUEL E. CALADO, JR. - CSDD-QSO-TESDA
    4. MR. VENZEL V. CONCOLES - CSDD-QSO-TESDA

  - National Institute for Technical Education and Skills Development (NITESD)
    1. AGNES P. PANEM - CTADD/NITESD
    2. FAMY I. PEPITO - CTADD/NITESD
    3. RAMON SANTIAGO - CTADD/NITESD