TRAINING REGULATIONS

ELECTRONICS/SEMICONDUCTOR PRODUCTION LINE MACHINE SERVICING NC III

ELECTRICAL & ELECTRONICS SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Superhighway, 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 AND ELECTRONICS SECTOR

ELECTRONICS/SEMICONDUCTOR PRODUCTION LINE MACHINE SERVICING

NATIONAL CERTIFICATE LEVEL III

TRAINING REGULATIONS FOR
ELECTRONICS/SEMICONDUCTOR PRODUCTION LINE
MACHINE SERVICING NC III

SECTION 1: ELECTRONICS/SEMICONDUCTOR PRODUCTION LINE MACHINE SERVICING NC III QUALIFICATION

The Electronics/Semiconductor Production Line Machine Servicing NC III Qualification consists of competencies that must be possessed to enable a person to perform machine setup/conversion, monitor machine performance, perform machine troubleshooting and repair and to perform preventive maintenance and calibration.

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

The units of competency comprising this qualification include the following:

Code	BASIC COMPETENCIES
500311109	Lead workplace communication
500311110	Lead small teams
500311111	Develop and practice negotiation skills
500311112	Solve problems related to work activities
500311113	Use mathematical concepts and techniques
500311114	Use relevant technologies
500311142	Apply critical thinking and problem solving techniques in the workplace
500311143	Evaluate current sustainable development exercises in the workplace

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
ELC311309	Perform Machine Setup/Conversion
ELC311310	Monitor Machine Performance
ELC311311	Perform Machine Troubleshooting and Repair
ELC311312	Perform Machine Preventive Maintenance and Calibration

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

> ➢ Electronics/Semiconductor Machine Technician
> ➢ Machine Maintenance Technician

SECTION 2: COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common, and core units of competency required for Electronics/Semiconductors Production Line Machine Servicing NC III.

BASIC COMPETENCIES

UNIT OF COMPETENCY : LEAD WORKPLACE COMMUNICATION

UNIT CODE   : 500311109

UNIT DESCRIPTOR   : This unit covers the knowledge, skills and attitudes   required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Communicate information about workplace processes	1.1. Appropriate ***communication method*** is selected 1.2. Multiple operations involving several topics areas are communicated accordingly 1.3. Questions are used to gain extra information 1.4. Correct sources of information are identified 1.5. Information is selected and organized correctly 1.6. Verbal and written reporting is undertaken when required 1.7. Communication skills are maintained in all situations	1.1. Organization requirements for written and electronic communication methods 1.2. Effective verbal communication methods 1.3. Methods of Communication 1.4. Types of Question 1.5. Communication Tools 1.6. Questioning Techniques	1.1. Organizing information 1.2. Understanding and conveying intended meaning 1.3. Participating in variety of workplace discussions 1.4. Complying with organization requirements for the use of written and electronic communication methods 1.5. Reporting occupational hazards during safety meeting
2. Lead workplace discussions	2.1 Response to workplace issues are sought 2.2 Response to workplace issues are provided immediately 2.3 Constructive contributions are made to workplace discussions on such issues as production, quality and safety 2.4 Goals/objectives and action plan are undertaken in the workplace are communicated	2.1 Leading as a management function 2.2 Barriers of communication 2.3 Effective verbal communication methods 2.4 Method/techniques of discussion 2.5 How to lead discussion 2.6 How to solicit response 2.7 Goal setting and action planning	2.1 Communicating effectively 2.2 Consulting the crew on the prepared menu for the month

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Identify and communicate issues arising in the workplace	3.1 Issues and problems are identified as they arise 3.2 Information regarding problems and issues are organized coherently to ensure clear and effective communication 3.3 Dialogue is initiated with appropriate personnel 3.4 Communication problems and issues are raised as they arise	3.1 Types of issues and problems in the workplace 3.2 Written and electronic communication methods 3.3 Communication barriers affecting workplace discussions	3.1 Identifying cause of problems 3.2 Identifying problems and issues 3.3 Organizing information on problems and issues 3.4 Relating problems and issues in the workplace

RANGE OF VARIABLES

VARIABLE	RANGE
1. Methods of communication	1.1. Non-verbal gestures 1.2. Verbal 1.3. Face to face 1.4. Two-way radio 1.5. Speaking to groups 1.6. Using telephone 1.7. Written 1.8. Internet

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Dealt with a range of communication/information at one time 1.2. Made constructive contributions in workplace issues 1.3. Sought workplace issues effectively 1.4. Responded to workplace issues promptly 1.5. Presented information clearly and effectively written form 1.6. Used appropriate sources of information 1.7. Asked appropriate questions 1.8. Provided accurate information
2. Resource Implications	The following resources **MUST** be provided: 2.1. Variety of Information 2.2. Communication tools 2.3. Simulated workplace
3. Methods of Assessment	Competency in this unit must be assessed through 3.1. Written Examination 3.2. Oral Questioning 3.3. Portfolio
4. Context for Assessment	4.1. Competency may be assessed in the workplace or in simulated workplace environment

UNIT OF COMPETENCY : **LEAD SMALL TEAMS**

UNIT CODE : **500311110**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Provide team leadership	1.1. ***Work requirements*** are identified and presented to team members 1.2. Reasons for instructions and requirements are communicated to team members 1.3. ***Team members' queries and concerns*** are recognized, discussed and dealt with	1.1. Company policies and procedures 1.2. How performance expectations are set 1.3. Methods of Monitoring Performance 1.4. Client expectations 1.5. Team member's duties and responsibilities 1.6. Definition of Team 1.7. Skills and techniques in promoting team building 1.8. Up-to-date dissemination of instructions and requirements to members 1.9. Art of listening and treating individual team members concern	1.1. Communication skills required for leading teams 1.2. Team building skills 1.3. Negotiating skills 1.4. Evaluation skills
2. Assign responsibilities	2.1 Duties, and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task and according to company policy 2.2 Duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible	2.1 Concept of delegation 2.2 How to delegate 2.3 Understanding individual differences 2.4 Methods of monitoring performance 2.5 Duties and responsibilities of each team member 2.6 Knowledge in identifying each team member duties and responsibilities	2.1 Delegating skills 2.2 Identifying individual skills, knowledge and attitude as basis for allocating responsibilities 2.3 Identifying each team member duties and responsibilities
3. Set performance expectations for team members	3.1 Performance expectations are established based on client needs and according to assignment requirements 3.2 Performance expectations are based on individual team members' duties and area of responsibility	3.1 Definition of performance indicators/ criteria 3.2 Definition of team goals and expectations 3.3 Methods of monitoring performance 3.4 Client expectations 3.5 Team members' duties and responsibilities 3.6 Defining performance	3.1 Identifying performance indicators 3.2 Evaluating performance 3.3 Setting individual performance target/ expectation indicators

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	3.3 Performance expectations are discussed and disseminated to individual team members	expectations criteria	
4. Supervised team performance	4.1 ***Monitoring of performance*** takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2 Team members are provided with ***feedback***, positive support and advice on strategies to overcome any deficiencies 4.3 ***Performance issues*** which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy 4.4 Team members are kept informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and satisfaction 4.5 Team operations are monitored to ensure that employer/client needs and requirements are met 4.6 Follow-up communication is provided on all issues affecting the team 4.7 All relevant documentation is completed in accordance with company procedures	4.1 Understanding monitoring of work 4.2 How to undertake corrective action 4.3 Understanding feedback and procedure 4.4 Feedback reporting procedure 4.5 Methods of monitoring performance 4.6 Team member's duties and responsibilities 4.7 Monitoring team operation to ensure client needs and satisfaction	4.1 Monitoring skills 4.2 Setting priorities 4.3 Evaluating performance 4.4 Informal/ formal counseling skills

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work requirements	1.1. Client Profile 1.2. Assignment instructions
2. Team member's concerns	2.1. Roster/shift details
3. Monitor performance	3.1. Formal process 3.2. Informal process
4. Feedback	4.1. Formal process 4.2. Informal process
5. Performance issues	5.1. Work output 5.2. Work quality 5.3. Team participation 5.4. Compliance with workplace protocols 5.5. Safety 5.6. Customer service

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Maintained or improved individuals and/or team performance given a variety of possible scenario 1.2. Assessed and monitored team and individual performance against set criteria 1.3. Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf 1.4. Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed 1.5. Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members
2. Resource Implications	The following resources **MUST** 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 task
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1. Written Examination 3.2. Oral Questioning 3.3. Portfolio
4. Context for Assessment	4.1. Competency assessment may occur in workplace or any appropriately simulated environment 4.2. Assessment shall be observed while task are being undertaken whether individually or in-group

UNIT OF COMPETENCY: DEVELOP AND PRACTICE NEGOTIATION SKILLS

UNIT CODE   :   **500311111**

UNIT DESCRIPTOR   :   This unit covers the skills, knowledge and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Plan negotiations	1.1. Information on *preparing for negotiation* is identified and included in the plan 1.2. Information on creating *nonverbal environments* for positive negotiating is identified and included in the plan 1.3. Information on *active listening* is identified and included in the plan 1.4. Information on different *questioning techniques* is identified and included in the plan 1.5. Information is checked to ensure it is correct and up-to- date	1.1. Knowledge on Codes of practice and guidelines for the organization 1.2. Knowledge of organizations policy and procedures for negotiations 1.3. Decision making and conflict resolution strategies procedures 1.4. Concept of negotiation	1.1. Communication skills (verbal and listening) 1.2. Active listening 1.3. Setting conflict 1.4. Preparing conflict resolution 1.5. Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation 1.6. Interpersonal skills to develop rapport with other parties
2. Participate in negotiations	2.1 Criteria for successful outcome are agreed upon by all parties 2.2 Desired outcome of all parties are considered 2.3 Appropriate language is used throughout the negotiation 2.4 A variety of questioning techniques are used 2.5 The issues and processes are documented and agreed upon by all parties 2.6 Possible solutions are discussed and their viability assessed 2.7 Areas for agreement are confirmed and recorded 2.8 Follow-up action is agreed upon by all parties	2.1 Outcome of negotiation 2.2 Knowledge on Language 2.3 Different Questioning techniques 2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation	2.1 Negotiating skill 2.2 Communication skills (verbal and listening) 2.3 Observation skills 2.4 Interpersonal skills to develop rapport with other parties 2.5 Applying effective questioning techniques 2.6 Setting conflict

RANGE OF VARIABLES

VARIABLE	RANGE

1. Preparing for negotiation	1.1 Background information on other parties to the negotiation
	1.2 Good understanding of topic to be negotiated
	1.3 Clear understanding of desired outcome/s
	1.4 Personal attributes
	    1.4.1 self-awareness
	    1.4.2 self esteem
	    1.4.3 objectivity
	    1.4.4 empathy
	    1.4.5 respect for others
	1.5 Interpersonal skills
	    1.5.1 listening/reflecting
	    1.5.2 nonverbal communication
	    1.5.3 assertiveness
	    1.5.4 behavior labeling
	    1.5.5 testing understanding
	    1.5.6 seeking information
	    1.5.7 self-disclosing
	1.6 Analytic skills
	    1.6.1 observing differences between content and process
	    1.6.2 identifying bargaining information
	    1.6.3 applying strategies to manage process
	    1.6.4 applying steps in negotiating process
	    1.6.5 strategies to manage conflict
	    1.6.6 steps in negotiating process
	    1.6.7 options within organization and externally for resolving conflict

2. Nonverbal environments	2.1 Friendly reception 2.2 Warm and welcoming room 2.3 Refreshments offered 2.4 Lead in conversation before negotiation begins
3. Active listening	3.1 Attentive 3.2 Don't interrupt 3.3 Good posture 3.4 Maintain eye contact 3.5 Reflective listening
4. Questioning techniques	4.1 Direct 4.2 Indirect 4.3 Open-ended

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome 1.2 Participated in negotiation with at least one person to achieve an agreed outcome
2. Resource Implications	The following resources **MUST** be provided: 2.1 Room with facilities necessary for the negotiation process 2.2 Human resources (negotiators)
3. Methods of Assessment	Competency may be assessed through: 3.1 Written Examination 3.2 Oral questioning 3.3 Portfolio
4. Context for Assessment	4.1 Competency to be assessed in real work environment or in a simulated workplace setting.

UNIT OF COMPETENCY : **SOLVE PROBLEMS RELATED TO WORK ACTIVITIES**

UNIT CODE : **500311112**

UNIT DESCRIPTOR : This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

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

1. Identify the problem	1.1. Variances are identified from normal operating parameters; and product quality
	1.2. Extent, cause and nature of the problem are defined through observation, investigation and ***analytical techniques***
	1.3. ***Problems*** are clearly stated and specified
		1.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations
		1.2. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations
		  1.2.1. Relevant equipment and operational processes
		  1.2.2. Enterprise goals, targets and measures
		  1.2.3. Enterprise quality, OHS and environmental requirement
		  1.2.4. Enterprise information systems and data collation
		  1.2.5. Industry codes and standards
		1.3. Normal operating parameters and product quality
			1.1. Using range of formal problem solving techniques
			1.2. Identifying and clarifying the nature of the problem
			1.3. Evaluating the effectiveness of a present process in the workplace
			1.4. Applying analytical techniques
			1.5. Identifying and clarifying the nature of problem

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
2. Determine fundamental causes of the problem	2.1 Possible causes are identified based on experience and the use of problem solving tools / analytical techniques. 2.2 Possible cause statements are developed based on findings 2.3 Fundamental causes are identified per results of investigation conducted	2.1 Relevant equipment and operational processes 2.2 Enterprise goals, targets and measures 2.3 Enterprise quality, OHS and environmental requirements 2.4 Enterprise information systems and data collation 2.5 Industry codes and standards	2.1 Analysis of root causes
3. Determine corrective action	3.1 All possible options are considered for resolution of the problem 3.2 Strengths and weaknesses of possible options are considered 3.3 Corrective actions are determined to resolve the problem and possible future causes 3.4 **Action *plans*** are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures	3.1 Understanding the procedure in undertaking corrective action 3.2 Principles of decision making strategies and techniques 3.3 Enterprise information systems and data collation 3.4 Action planning	3.1 Identifying and clarifying the nature of the problem 3.2 Devising the best solution 3.3 Evaluating the solution 3.4 Implementing developed plan to rectify the problem 3.5 Implementing corrective and preventive actions based on root cause analysis
4. Provide recommend-ation/s to manager	4.1 Report on recommendations is prepared according to procedures. 4.2 Recommendations are presented to appropriate personnel. 4.3 Recommendations are followed-up, if required	4.1 How to make a report and recommendation	4.1 Writing report and recommendations

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	1.1. Brainstorming 1.2. Intuitions/Logic 1.3. Cause and effect diagrams 1.4. Pareto analysis 1.5. SWOT analysis 1.6. Gant chart, Pert CPM and graphs 1.7. Scattergrams
2. Problem	2.1. Non – routine process and quality problems 2.2. Equipment selection, availability and failure 2.3. Teamwork and work allocation problem 2.4. Safety and emergency situations and incidents
3. Action plans	3.1. Priority requirements 3.2. Measurable objectives 3.3. Resource requirements 3.4. Timelines 3.5. Co-ordination and feedback requirements 3.6. Safety requirements 3.7. Risk assessment 3.8. Environmental requirements

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Identified the problem 1.2. Determined the fundamental causes of the problem 1.3. Determined the correct / preventive action 1.4. Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Resource Implications	2.1. 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 reason behind the observable action.
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1. Written Examination 3.2. Oral Questioning 3.3. Portfolio
4. Context for Assessment	4.1. In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units.

UNIT OF COMPETENCY: USE MATHEMATICAL CONCEPTS AND TECHNIQUES

UNIT CODE   :   500311113

UNIT DESCRIPTOR   :   This unit covers the knowledge, skills and attitudes required in the   application of mathematical concepts and techniques.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Identify mathematical tools and techniques to solve problem	1.1 Problem areas are identified based on given condition 1.2 ***Mathematical techniques*** are selected based on the given problem	1.1 Fundamental operation (addition, subtraction, division, multiplication) 1.2 Units of measurement and its conversion 1.3 Fundamental of units 1.4 Standard formulas 1.5 Basic measuring tools/devices 1.6 Measurement system 1.7 Basic measuring tools/devices 1.8 Steps in solving problem	1.1 Identifying and selecting different measuring tools 1.2 Applying different formulas in solving problems 1.3 Describing the units of measurement and fundamental units 1.4 Stating arithmetic calculations involving the following; addition, subtraction, division, multiplication 1.5 Applying theory into actual application on shipboard catering processes
2. Apply mathematical procedure/ solution	2.1 Mathematical techniques are applied based on the problem identified 2.2 Mathematical computations are performed to the level of accuracy required for the problem 2.3 Results of mathematical computation is determined and verified based on job requirements	2.1 Problem-based questions 2.2 Estimation 2.3 Use of mathematical tools and standard formulas 2.4 Mathematical techniques	2.1 Solving mathematical computations 2.2 Converting Metric to English 2.3 Selecting and using appropriate and efficient techniques and strategies to solve problems
3. Analyze results	3.1 Result of application is reviewed based on expected and required specifications and outcome 3.2 ***Appropriate action*** is applied in case of error	3.1 Techniques in analyzing the results 3.2 Process in reviewing the results 3.3 Precision & accuracy 3.4 Four fundamental operations 3.5 Steps in solving problem 3.6 formulas 3.7 Conversion measurement	3.1 Analyzing the result based on the specified requirements 3.2 Interpreting and communicating the results of the analysis

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RANGE OF VARIABLES

VARIABLE	RANGE
1. Mathematical techniques	May include but are not limited to: 1.1 Four fundamental operations 1.2 Measurements 1.3 Use/Conversion of units of measurements 1.4 Use of standard formulas
2. Appropriate action	2.1 Review in the use of mathematical techniques (e.g. recalculation, re-modeling) 2.2 Report error to immediate superior for proper action

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Identified, applied and reviewed the use of mathematical concepts and techniques to workplace problems
2. Resource Implications	The following resources **MUST** be provided: 2.1 Calculator 2.2 Basic measuring tools 2.3 Case Problems
3. Methods of Assessment	Competency may be assessed through: 3.1 Authenticated portfolio 3.2 Written Test 3.3 Interview/Oral Questioning 3.4 Demonstration
4. Context for Assessment	4.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: USE RELEVANT TECHNOLOGIES

UNIT CODE   :   500311114

UNIT DESCRIPTOR   : This unit of competency covers the knowledge, skills, and attitude required in selecting, sourcing and applying appropriate and affordable technologies in the workplace.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Study/select appropriate technology	1.1 Usage of different *technologies* is determined based on job requirements 1.2 Appropriate technology is selected as per work specification	1.1 Awareness on technology and its function 1.2 Communication techniques 1.3 Health and safety procedure 1.4 Company policy in relation to relevant technology 1.5 Machineries/ equipment and their application 1.6 Software programs	1.1 Identifying relevant technology on job
2. Apply relevant technology	2.1 Relevant technology is effectively used in carrying out function 2.2 Applicable software and hardware are used as per task requirement 2.3 **Management concepts** are observed and practiced as per established industry practices	2.1 Knowledge on operating instructions 2.2 Understanding software and hardware system 2.3 Communication techniques 2.4 Health and safety procedure 2.5 Company policy in relation to relevant technology 2.6 Different management concepts 2.7 Technology adaptability	2.1 Applying relevant technology 2.2 Communicating skills 2.3 Using software applications skills 2.4 Conducting risk assessment
3. Maintain/ enhance relevant technology	3.1 Maintenance of technology is applied in accordance with the *industry standard operating procedure*, *manufacturer's operating guidelines* and *occupational health and safety procedure* to ensure its operative ability	3.1 Awareness on technology and its function 3.2 Repair and maintenance procedure 3.3 Health and safety procedure 3.4 Company policy in relation to relevant technology	3.1 Performing basic troubleshooting skills 3.2 Identifying failures or defects 3.3 Communication skills 3.4 Applying corrective and preventive maintenance

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ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	3.2 Updating of technology is maintained through continuing education or training in accordance with job requirement 3.3 Technology failure/ defect is immediately reported to the concern/responsible person or section for *appropriate action*	3.5 Upgrading of technology 3.6 Organizational set-up/work flow	

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technology	May include but are not limited to: 1.1 Office technology 1.2 Industrial technology 1.3 System technology 1.4 Information technology 1.5 Training technology
2. Management concepts	May include but not limited to: 2.1 Real Time Management 2.2 KAIZEN or continuous improvement 2.3 5s 2.1 Total Quality Management 2.2 Other management/productivity tools
3. Industry standard operating procedure	3.1 Written guidelines relative to the usage of office technology/equipment 3.2 Verbal advise/instruction from the co-worker
4. Manufacturer's operating guidelines/ instructions	4.1 Written instruction/manuals of specific technology/ equipment 4.2 General instruction manual 4.3 Verbal advise from manufacturer relative to the operation of equipment
5. Occupational health and safety procedure	5.1 Relevant statutes on OHS 5.2 Company guidelines in using technology/equipment
6. Appropriate action	6.1 Implementing preventive maintenance schedule 6.2 Coordinating with manufacturer's technician

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Studied and selected appropriate technology consistent with work requirements 1.2 Applied relevant technology 1.3 Maintained and enhanced operative ability of relevant technology
2. Resource Implications	The following resources **MUST** be provided: 2.1 Relevant technology 2.2 Interview and demonstration questionnaires 2.3 Assessment packages
3. Methods of Assessment	Competency must be assessed through: 3.1 Interview 3.2 Actual demonstration 3.3 Authenticated portfolio (related certificates of training/seminar)
4. Context for Assessment	4.1 Competency may be assessed in actual workplace or simulated environment

UNIT OF COMPETENCY : **APPLY CRITICAL THINKING AND PROBLEM SOLVING TECHNIQUES IN THE WORKPLACE**
UNIT CODE **:** **500311142**
UNIT DESCRIPTOR **:** This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems

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

1. Identify the problem	1.1. Variances are identified from normal operating parameters; and product quality
	1.2. Extent, cause and nature are of the problem are defined through observation, investigation and ***analytical techniques***
	1.3. ***Problems*** are clearly stated and specified
		1.1. Planning and preparing task/activity
		1.2. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize nonstandard situations
		1.3. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations
		    1.3.1. Relevant equipment and operational processes
		    1.3.2. Enterprise goals, targets and measures
		    1.3.3. Enterprise quality, OHS and environmental requirement
		    1.3.4. Enterprise information systems and data collation
		    1.3.5. Industry codes and standards
			1.1. Using range of formal problem solving techniques
			1.2. Identifying and clarifying the nature of the problem

2. Determine fundamental causes of the problem	2.1. Possible causes are identified based on experience and the use of problem solving tools / analytical techniques 2.2. Possible cause statements are developed based on findings 2.3. Fundamental causes are identified per results of	2.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize nonstandard situations 2.2. Competence to include the ability to apply and explain, sufficient for the identification of	2.1. Using range of formal problem solving techniques 2.2. Identifying and clarifying the nature of the problem

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	investigation conducted	fundamental cause, determining the corrective action and provision of recommendations 2.2.1. Relevant equipment and operational processes 2.2.2. Enterprise goals, targets and measures 2.2.3. Enterprise quality, OHS and environmental requirement 2.2.4. Enterprise information systems and data collation 2.2.5. Industry codes and standards	
3. Determine corrective action	3.1. All possible options are considered for resolution of the problem 3.2. Strengths and weaknesses of possible options are considered 3.3. Corrective actions are determined to resolve the problem and possible future causes 3.4. *Action plans* are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures	3.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 3.2. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 3.2.1. Relevant equipment and operational processes 3.2.2. Enterprise goals, targets and measures 3.2.3. Enterprise quality, OHS and environmental requirement 3.2.4. Principles of decision making strategies and techniques 3.2.5. Enterprise information systems and data collation 3.2.6. Industry codes and standards	3.1. Using range of formal problem solving techniques 3.2. Identifying and clarifying the nature of the problem 3.3. Devising the best solution 3.4. Evaluating the solution 3.5. Implementation of a developed plan to rectify the problem
4. Provide	4.1. Report on	4.1. Competence includes a	4.1. Using range of

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
recommend-ation/s to manager	recommendations are prepared 4.2. Recommendations are presented to appropriate personnel. 4.3. Recommendations are followed-up, if required	thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations	formal problem solving techniques 4.2. Identifying and clarifying the nature of the problem 4.3. Devising the best solution 4.4. Evaluating the solution 4.5. Implementation of a developed plan to rectify the problem

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	May include: 1.1. Brainstorming 1.2. Intuitions/Logic 1.3. Cause and effect diagrams 1.4. Pareto analysis 1.5. SWOT analysis 1.6. Gant chart, Pert CPM and graphs 1.7. Scattergrams
2. Problem	May include: 2.1. Non – routine process and quality problems 2.2. Equipment selection, availability and failure 2.3. Teamwork and work allocation problem 2.4. Safety and emergency situations and incidents
3. Action plans	May include: 3.1. Priority requirements 3.2. Measurable objectives 3.3. Resource requirements 3.4. Timelines 3.5. Co-ordination and feedback requirements 3.6. Safety requirements 3.7. Risk assessment 3.8. Environmental requirements

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence that the candidate: 1.1. Identified the problem 1.2. Determined the fundamental causes of the problem 1.3. Determined the correct / preventive action 1.4. Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Method of assessment	Competency in this unit may be assessed through: 2.1. Case studies on solving problems in the workplace 2.2. Observation The unit will be assessed in a holistic manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation. Simulation may be required to allow for timely assessment of parts of this unit of competency. Simulation should be based on the actual workplace and will include walk through of the relevant competency components.
3. Resource Implication	3.1. 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 reason behind the observable action.
4. Context of Assessment	4.1. In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units

UNIT TITLE   **:**   **EVALUATE CURRENT SUSTAINABLE DEVELOPMENT EXERCISES IN THE WORKPLACE**

UNIT CODE   **:**   **500311143**

UNIT DESCRIPTOR **:**   This unit covers the knowledge, skills and attitudes required to investigate current practices in relation to resource usage, set targets for improvements, implement performance improvement strategies and monitor performance.

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Investigate current practices in relation to resource usage	1.1. Environmental regulations applying to the enterprise are identified 1.2. Procedures for assessing compliance with environmental regulations are assessed following environmental protocols 1.3. Information on environmental and resource efficiency systems and procedures are collected and provided to the work group where appropriate 1.4. Current resource usage is measured and recorded by members of the work group 1.5. Current purchasing strategies are analyzed and recorded according to industry procedures 1.6. Current work processes to access information and data is analysed following enterprise protocol 1.7. Assistance in identifying areas for improvement in accessing information is provided based on the result of analysis	1.1. Environmental regulations applying to the enterprise. 1.2. Procedures for assessing compliance with environmental regulations. 1.3. Collection information on environmental and resource efficiency systems and procedures, 1.4. Measurement and recording of current resource usage 1.5. Analysis and recording of current purchasing strategies. 1.6. Analysis current work processes to access information and data 1.7. Analysis of data and information 1.8. Identification of areas for improvement	1.1. Identifying environmental regulations 1.2. Assessing procedures for assessing compliance 1.3. Collecting information on environmental and resource efficiency systems and procedures, and 1.4. Providing information to the work group 1.5. Measuring and recording current resource usage 1.6. Analysing and recording current purchasing strategies. 1.7. Analysing current work processes to access information and data and 1.8. Assisting identifying areas for improvement
2. Set targets for improvements	2.1. Inputs from *authorized sources* are sought following industry procedures. 2.2. External sources of information and data are accessed according to established protocols 2.3. Alternative solutions to workplace environmental issues are evaluated following environmental regulations.	2.1. Inputs from stakeholders, key personnel and specialist. 2.2. Procedures to access to external sources of information and data 2.3. Evaluation of alternative solutions to	2.1. Seeking input from stakeholders, key personnel and specialist. 2.2. Accessing external sources of information and data. 2.3. Evaluating alternative solutions

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TR – Electronics/Semiconductor Production Line Machine Servicing NC III   Promulgated December 18, 2017   26

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	2.4. Efficiency targets are set based on evaluation and objectives.	workplace environmental issues 2.4. Methods of setting efficiency targets	2.4. Setting efficiency targets.
3. Implement performance improvement strategies	3.1. Techniques/tools to assist in achieving targets are sourced according to industry protocol. 3.2. Continuous improvement strategies to own work area of responsibility are applied based on targets 3.3. Ideas and possible solutions are communicated to the work group and management. 3.4. Environmental and resource efficiency improvement plans for own work group are integrated and implemented with other operational activities according to ***organizational systems and procedures***. 3.5. Suggestions and ideas about environmental and resource efficiency management are sought from stakeholders 3.6. Collected suggestions and ideas are act upon based on work requirements and need. 3.7. Costing strategies are implemented to fully value environmental assets	3.1. Sources of techniques/tools 3.2. Application of continuous improvement strategies 3.3. Ideas and possible solutions to the work group and management. 3.4. Integration and implementation of environmental and resource efficiency improvement plans 3.5. Methods of seeking suggestions and ideas about environmental and resource efficiency management from stakeholders 3.6. Action taken for the collected suggestion and ideas 3.7. Implementation of costing strategies to fully value environmental assets	3.1. Sourcing techniques/tools 3.2. Applying continuous improvement strategies 3.3. Integrating and implementing environmental and resource efficiency improvement plans. 3.4. Seeking suggestions and ideas 3.5. Acting on collected suggestions and ideas 3.6. Implementing costing strategies
4. Monitor performance	4.1. Evaluation and monitoring tools and technology are used following industry procedures and manuals. 4.2. Evaluation and monitoring, tools and technology are developed following industry protocol 4.3. Outcomes to report on efficiency targets are document and communicated to key personnel and stakeholders 4.4. Strategies are evaluated according industry protocol	4.1. Evaluation and monitoring of tools and technology 4.2. Documentation of outcomes and communicate reports 4.3. Evaluation of strategies. 4.4. Setting of new targets 4.5. Investigation and application of new tools and strategies.	4.1. Using evaluation and monitoring tools and technology 4.2. Developing evaluation and monitoring tools and technology 4.3. Documenting and communicating outcomes to reports 4.4. Evaluating strategies 4.5. Setting new

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	4.5. New targets are set based on evaluation. 4.6. New tools and strategies are investigated and applied following industry established procedures. 4.7. Successful strategies are promoted. 4.8. Participants are rewarded according to established criteria.	4.6. Promotion of successful strategies 4.7. Compensation through reward giving to participants	targets 4.6. Investigating and applying new tools and strategies. 4.7. Promoting successful strategies 4.8. Compensating participants of successful strategies

RANGE OF VARIABLES

VARIABLE	RANGE
1. Authorized sources	May include: 1.1 Stakeholders 1.2 Key personnel 1.3 specialist
2. Organization systems and procedures	May include: 2.1 Supply chain, procurement and purchasing 2.2 Quality assurance 2.3 Making recommendations and seeking approvals

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence that the candidate: 1.1. Investigated current practices in relation to resource usage. 1.2. Set targets for improvements. 1.3. Implemented performance improvement strategies 1.4. Monitored performance
2. Resource Implication	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. Method 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 of Assessment	4.1. Competency may be assessed in actual workplace or at the designated TESDA center.

COMMON COMPETENCIES

UNIT TITLE   :   **USE HAND TOOLS**
UNIT CODE   :   **ELC724201**
UNIT DESCRIPTOR :   This unit covers the knowledge, skills and attitudes on the safe use, handling and maintenance of tools.

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* 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	1.1. Planning and preparing task/activity 1.2. Electronics hand tools and their uses 1.3. Function, operation and common faults in electronics hand tools	1.1. Preparing required tasks 1.2. Communication skills 1.3. 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	2.1. Checking and safety requirements in handling tools 2.2. Standard procedures in checking, identification and marking of safe or unsafe/ faulty tools	2.1. Identifying and checking hand tools 2.2. 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
		3.1. Safety requirements in using electronics hand tools and test equipment
		3.2. Electronics hand tools for adjusting, dismantling, assembling, finishing, and cutting.
		3.3. Processes, Operations, Systems
		   3.3.1. Proper usage and care of hand tools
		   3.3.2. Types and uses of test equipment
		3.4. Common faults in the use of hand tools
			3.1. Reading skills required to interpret work instruction and numerical skills
			3.2. Using PPE properly
			3.3. 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
		4.1. Safety requirements in maintenance of hand tools
		4.2. Processes, Operations, Systems
		   4.2.1. Maintenance of tools
		   4.2.2. Storage of hand tools
			4.1. Checking and cleaning hand tools
			4.2. Storing hand tools properly

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hand tools	1.1. 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 requires evidence 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	3.1. Tools may include the following but not limited to: 3.1.1. screw drivers 3.1.2. pliers 3.1.3. punches 3.1.4. wrenches, files
4. Context of Assessment	4.1. 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 Bold* 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 1.2. Correct specifications are obtained from relevant source 1.3. Measuring tools are selected in line with job requirements	1.1. Category of measuring instruments 1.2. Types and uses of measuring instruments 1.3. Shapes and Dimensions 1.4. Formulas for volume, areas, perimeters of plane and geometric figures	1.1. Identifying and selecting measuring instruments 1.2. Visualizing objects and shapes
2. Carry out measurements and calculation	2.1. Appropriate ***measuring instrument*** is selected to achieve required outcome 2.2. Accurate measurements are obtained for job 2.3. ***Calculation*** needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x), and division (/) 2.4. Calculation involving fractions, percentages and mixed numbers are used to complete workplace tasks. 2.5. Numerical computation is self-checked and corrected for accuracy 2.6. Instruments are read to the limit of accuracy of the tool.	2.1. Calculation & measurement 2.2. Four fundamental operation 2.3. Linear measurement 2.4. Dimensions 2.5. Unit conversion 2.6. Ratio and proportion	2.1. Performing calculation by addition, subtraction, multiplication and division; 2.2. Interpreting formulas for volume, areas, perimeters of plane and geometric figures 2.3. Handling of measuring instruments
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.	3.1. Types of measuring instruments and their uses 3.2. Safe handling procedures in using measuring instruments 3.3. Four fundamental operation of mathematics 3.4. Formula for volume, area, perimeter and other geometric figures	3.1. Handling and maintaining measuring instruments

RANGE OF VARIABLES

VARIABLE	RANGE
1. Measuring instruments	1.1. Straight edge 1.2. Torque gauge 1.3. Try square 1.4. Protractor 1.5. Combination gauge 1.6. Steel rule
2. Calculation	Kinds of part mensuration includes the following but not limited to: 2.1. Volume 2.2. Area 2.3. Displacement 2.4. Inside diameter 2.5. Circumference 2.6. Length 2.7. Thickness 2.8. Outside diameter 2.9. Taper 2.10. Out of roundness

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence 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. Method of assessment	Competency in this unit must be assessed through: 2.1. Observation 2.2. Oral questioning
3. Resource implication	3.1. Place of assessment 3.2. Measuring instruments 3.3. Straight edge 3.4. Torque gauge 3.5. Try square 3.6. Protractor 3.7. Combination gauge 3.8. Steel rule
4. Context of Assessment	4.1. 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 Bold* 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	1.1. Types of technical drawings 1.2. Applications for technical drawing 1.3. Methods of technical drawings 1.4. Symbols 1.5. Mark up/Notation of Drawings	1.1. Reading skills required to interpret work instruction 1.2. 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.
		2.1. Trade Mathematics
		   o Linear measurement
		   o Dimension
		   o Unit conversion
		 2.2. Blueprint Reading and Plan Specs
		   o Architectural, electrical, electronics, mechanical plan, symbols and abbreviations
		   o Drawing standard symbols
		 2.3. Trade Theory
		   o Basic technical drawing
		   o Types technical plans
		   o Various types of drawings
		   o Notes and specifications
			2.1. Interpreting drawing/ orthographic drawing
			 2.2. Interpreting technical plans
			 2.3. Matching specification details with existing resources
			 2.4. 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.
		3.1. Drawing conventions
		 3.2. Dimensioning Conventions
		 3.3. Mathematics
		   o 4 Fundamental Operations
		     - Percentage
		     - Fraction
		     - Algebra
		     - Geometry
			3.1. Reading skills required to interpret work instruction
			 3.2. Communication skills
			 3.3. Preparing/Making electrical/ electronic signs and symbols
			 3.4. Computing formulas

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* 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.
		4.1. Effective ways to catalogue and store technical drawings
		4.2. Manual methods of handling, storing and maintaining paper drawings
		4.3. Storing drawing in digital forms
		   o Scanner
		   o CAD
			4.1. Handling and storing of drawings
			4.2. Scanning and storing drawings in digital form
			4.3. Matching specification details with existing resources
			4.4. 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 requires evidence 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	4.1. Assessment may be conducted in the workplace or in a simulated work environment

UNIT TITLE : **APPLY QUALITY STANDARDS**
UNIT CODE : **ELC315202**
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 Bold* 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	1.1. Relevant production processes, materials and products 1.2. Characteristics of materials, software and hardware used in production processes 1.3. Quality checking procedures 1.4. Quality Workplace procedures 1.5. Identification of faulty materials related to work	1.1. Reading skills required to interpret work instruction 1.2. Critical thinking 1.3. 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. Deviations from specified ***quality standards***, causes are documented and reported in accordance with the workplace' standards operating procedures	2.1. Safety and environmental aspects of production processes 2.2. Fault identification and reporting 2.3. Workplace procedure in documenting completed work 2.4. Workplace Quality Indicators	2.1. Carry out work in accordance with OHS policies and procedures
3. Engage in	3.1. Process improvement procedures are participated	3.1. Quality improvement	3.1. Solution providing and

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
quality improvement	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	processes 3.2. Company customers defined	decision-making 3.2. 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	4.1. Quality standards may relate but not limited to the following:
	    4.1.1. materials
	    4.1.2. component parts
	    4.1.3. final product
	    4.1.4. production processes

5. Customer	5.1. Co-worker 5.2. Supplier 5.3. Client 5.4. Organization receiving the product or service

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence 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	Competency in this unit must be assessed through: 3.1 Observation 3.2 Oral Questioning 3.3 Practical demonstration
3. Resource implication	3.1. Materials and component parts and equipment to be used in a real or simulated electronic production situation
4. Context of Assessment	4.1. Assessment may be conducted in the workplace or in a simulated work 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 Bold* 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 according to job specifications 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 1.4. Client -specific guidelines and procedures are followed. 1.5. Required data security guidelines are applied in accordance with existing procedures.	1.1. Main types of computers and basic features of different operating systems 1.2. Main parts of a computer 1.3. Information on hardware and software 1.4. Data security guidelines	1.1. Reading and comprehension skills required to interpret work instruction and to interpret basic user manuals. 1.2. Communication skills to identify lines of communication, request advice, follow instructions and receive feedback. 1.3. 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**	2.1. Basic ergonomics of keyboard and computer user 2.2. Storage devices and basic categories of memory 2.3. Relevant types of software	2.1. Technology skills to use equipment safely including keyboard skills. 2.2. 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	3.1. General security, privacy legislation and copyright 3.2. Productivity Application 3.3. Business Application	3.1. Accessing information 3.2. Searching and browsing files and data

ELEMENT	PERFORMANCE CRITERIA Italicized Bold terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	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		
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	4.1. Computer application in printing, scanning and sending facsimile 4.2. Types and function of computer peripheral devices	4.1. Computer data processing 4.2. Printing of data 4.3. 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	5.1. Computer equipment/ system basic maintenance procedures 5.2. Viruses 5.3. OH & S principles and responsibilities 5.4. Calculating computer capacity 5.5. System Software 5.6. Basic file maintenance procedures	5.1. Removing computer viruses from infected machines 5.2. 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 requires evidence that the candidate: 1.1. Planned and prepared for task to be undertaken 1.2. Inputted data into computer 1.3. Accessed information using computer 1.4. Produced/outputted data using computer system 1.5. Maintained computer equipment and systems
2. Method of assessment	Competency in this unit must be assessed through: 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	4.1. Assessment may be conducted in the workplace or in a simulated environment

UNIT TITLE : **TERMINATE AND CONNECT ELECTRICAL WIRING AND ELECTRONICS CIRCUIT**
UNIT CODE : **ELC724202**
UNIT DESCRIPTOR : This unit covers the knowledge, skills, 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	1.1. Use of tools 1.2. Use of test instruments / equipment 1.3. Electrical theory 1.4. Principals of AC and DC 1.5. OH & S guidelines and procedures 1.6. Basic electrical and electronic devices	1.1. Reading skills required to interpret work instruction 1.2. Checking materials for conformance to specifications 1.3. 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. Work is 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 according to job specifications 2.5. **Accessories** used are adjusted, if necessary 2.6. Confirm termination/ connection undertaken successfully in accordance with job specification	2.1. Wiring techniques 2.2. OH & S principles 2.3. Use of lead-free soldering technology 2.4. Specifications and methods for terminating different materials	2.1. Communication skills 2.2. 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	3.1. AC and DC power supplies 3.2. Use of diagnostic equipment 3.3. Surface mount soldering techniques 3.4. Tests for wiring and connections 3.5. Wiring support techniques and alternatives	3.1. Soldering techniques 3.2. Printed circuit board repair and techniques 3.3. Electronic assembly functional and quality testing 3.4. Undertaking testing of wiring and connections for conformance to specification 3.5. Using language and literacy skills to complete short reports and required 3.6. Adjusting and fixing wiring supports

RANGE OF VARIABLES

VARIABLE	RANGE

1. Materials	1.1 Materials included the following but not limited to:
	    1.1.1 Soldering lead
	    1.1.2 Cables
	    1.1.3 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	5.1 Accessories may include the following but not limited to:
	    5.1.1 brackets
	    5.1.2 clamps

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence 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	Competency in this unit must be assessed through: 2.1. Observation 2.2. Oral Questioning 2.3. Practical demonstration
3. Resource implication	Tools for measuring, cutting, drilling, assembling/ disassembling, connection. Tool set includes the following but not limited to: 3.1 screw drivers 3.2 pliers 3.3 cutters
4. Context of Assessment	4.1. Assessment may be conducted in the workplace or in a simulated environment

UNIT OF COMPETENCY: TEST ELECTRONIC COMPONENTS

UNIT CODE   :   ELC724205

UNIT DESCRIPTOR   :   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
		1.1 Mensuration/ Mathematics
		   1.1.1 Conversion of Units
		   1.1.2 Applied Mathematics
		1.2 Safety
		   1.2.1 Work Safety requirements and economy of materials with durability
		1.3 Systems and Processes
		   1.3.1 Principles of electrical/ electronic circuits
		   1.3.2 Identifying sources of electricity
		   1.3.3 Identifying conductors and insulators
		   1.3.4 Supplying different voltage using variable power supply
		   1.3.5 Measuring resistance using VOM
		   1.3.6 Testing resistors
		   1.3.7 Measuring current and voltage using VOM
		1.4 Testing Criteria
		   1.4.1 controls
		   1.4.2 effectiveness
		   1.4.3 efficiency
		   1.4.4 bug detection
		   1.4.5 functionality, including flow
		   1.4.6 interoperability
		   1.4.7 performance
		   1.4.8 reliability
		   1.4.9 operating parameters
			1.1 Work efficiently & systematically
			1.2 Communication skills
			1.3 Use and maintenance of tools and equipment
			1.4 Skills in testing electronic components
			1.5 Work safety practices and time management
			1.6 Problem solving skills
			1.7 Reading skills

2. Plan an	2.1 Various ***testing methods***	2.1. Safety	2.1 Work efficiently

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

approach for component testing	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 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
		2.1.1. Work Safety requirements and economy of materials with durability
		 2.1.2. Knowledge in 5S application and observation of required timeframe
		 2.2. Materials, tools and equipment uses and specifications
		     2.2.1. Proper care and use of tools
		 2.3. Types of electronic components
		     2.3.1. Passive components
		     2.3.2. Active components
		     2.3.3. Dynamic components
		     2.3.4. Hybrid components
		 2.4. Testing methods
		     2.4.1. automated
		     2.4.2. debugging
		     2.4.3. inspection
		     2.4.4. platform testing
		     2.4.5. prototyping
		 2.5. Systems and Processes
		     2.5.1. Describing resistance and identify resistors
		     2.5.2. Describing alternating current circuits
		     2.5.3. Describing capacitance and identifying capacitors
		     2.5.4. Describing inductance and identifying inductors
		     2.5.5. describing the characteristic of transformers
		     2.5.6. describing and
			& systematically
			 2.2 Communication skills
			 2.3 Use and maintenance of tools and equipment
			 2.4 Skills in testing electronic components
			 2.5 Work safety practices and time management
			 2.6 Problem solving skills
			 2.7 Reading skills

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
		identifying semiconductor diode 2.5.7. describing and identifying bipolar transistor 2.5.8. describing and analyzing digital gate	

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 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
		3.1. Safety
		  3.1.1. Work Safety requirements and economy of materials with durability
		3.2. Materials, tools and equipment uses and specifications
		  3.2.1. Proper care and use of tools
		3.3. Systems and Processes
		  3.3.1. Principles of electrical/ electronic circuits
		  3.3.2. Supplying different voltage using variable power supply
		  3.3.3. Measuring resistance using VOM
		  3.3.4. Testing resistors
		  3.3.5. Measuring current and voltage using VOM
		  3.3.6. Observing waveform using oscilloscope
		  3.3.7. generating waveform in various frequency using function generator
		  3.3.8. Measuring frequency using oscilloscope
		  3.3.9. Measuring capacitance using
			3.1 Work efficiently & systematically
			3.2 Communication skills
			3.3 Use and maintenance of tools and equipment
			3.4 Skills in testing electronic components
			3.5 Work safety practices and time management
			3.6 Problem solving skills
			3.7 Reading skills

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
		VOM 3.3.10. Testing capacitors 3.3.11. Testing inductors 3.3.12. testing semiconductor diode 3.3.13. testing bipolar transistor 3.3.14. testing logic gates	
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.	4.1. Evaluation of testing process and records system 4.2. Systems and Processes 4.2.1. Analyzing simple circuit using ohms and power law 4.2.2. Analyzing series/parallel circuits using ohms and power law 4.2.3. Analyzing series/parallel capacitances 4.2.4. analyzing series parallel inductors 4.2.5. analyzing rectifier circuits 4.2.6. analyzing amplifier circuit 4.2.7. analyzing multi-vibrator circuit 4.2.8. analyzing logic networks 4.2.9. analyzing sequence circuits	4.1 Work efficiently & systematically 4.2 Communication skills 4.3 Use and maintenance of tools and equipment 4.4 Skills in testing electronic components 4.5 Work safety practices and time management 4.6 Problem solving skills 4.7 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

VARIABLE	RANGE

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	1.8 Assessment maybe conducted in the workplace or in a simulated workplace setting

CORE COMPETENCIES

UNIT OF COMPETENCY : **PERFORM MACHINE SETUP/CONVERSION**

UNIT CODE : **ELC724364**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes needed in performing machine setup/conversion. This includes preparing tools, equipment and conversion kits, carrying out machine, electrical/ electronic setup/conversion and parameters setting as well as performing production setup buyoff.

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

1. Prepare setup tools, equipment and conversion kits	1.1 **Tools**, **equipment** and conversion kits are determined according to product and machine specifications
	1.2 Appropriate tools, equipment and conversion kits are selected and completed according to product, machine and setup time requirements
	1.3 Tools, equipment and conversion kits are checked if in good working condition and without physical defects.
		1.1. Familiarity with production line tools, equipment and conversion kits and their location
		1.2. Understanding machine manuals, procedures, work instructions and other applicable documents/ specifications.
		1.3. Awareness on safe handling of tools and materials i.e. 5S principles, Occupational Health and Safety (OHS), Material Safety Data Sheet (MSDS), Personal Protective Equipment (PPE), Electro Static Discharge (ESD), Environmental Health Systems (EHS), Cleanroom requirements and contamination control
		1.4. Awareness on IPC standards
		1.5. Awareness on international quality standards
		    1.5.1. Quality Management System
		    1.5.2. Environmental Management System
		1.6. Awareness on visual criteria on parts and tools
		1.7. Time consciousness on setup time
			1.1 Reading skills
			1.2 Basic mathematical skills
			1.3 Communication skills
			1.4 Computer skills
			1.5 Detect abnormality or non-conformance
			1.6 Writing skills

2. Carryout machine mechanical setup/ conversion	2.1 Safety procedures are followed according to occupational safety and health (OSH) standards 2.2 **Mechanical parts** are	2.1 Safety procedures and standards in mechanical setup/conversion 2.2 Interpretation of mechanical drawings	2.1 Read and interpret mechanical drawings 2.2 Apply

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	properly installed according to machine and product specifications and required setup time 2.3 Conversion parts/kits are properly installed/replaced according to machine and product specifications and required conversion time 2.4 Any non-conformance to specifications is reported to ***appropriate personnel.***	2.3 Knowledge in machine mechanical setup and conversion procedures 2.4 Knowledge on the use of setup jigs 2.5 Understand machine mechanical parts and functions (especially moving parts) 2.6 Knowledge with basic pneumatic parts and system 2.7 Knowledge with basic hydraulic parts and system 2.8 Awareness on safety operation of production line machines 2.9 Reading of different gauges 2.10 Awareness on setup criteria 2.11 Awareness on applicable Out of Control Action Plan (OCAP)	procedures in mechanical manuals 2.3 Use proper tools for a specific task 2.4 Detect abnormality or non-conformance 2.5 Install mechanical parts on machine
3. Carryout machine electrical/ electronic setup/ conversion	3.1 Safety procedures are followed according to occupational safety and health (OSH) standards 3.2 Electrical/Electronic parts are properly installed/ replaced according to machine and product specifications and required time 3.3 Electrical conversion parts/kits are properly installed/replaced according to machine and product specifications and required conversion time 3.4 Any non-conformance to specifications is reported to appropriate personnel	3.1 Safety procedures and standards in electrical/ electronic setup 3.2 Interpretation of electrical diagrams 3.3 Knowledge in machine electrical/ electronic setup procedures 3.4 Understand machine electrical/ electronic parts and functions 3.5 Awareness on safety operation of production line machines 3.6 Reading of different gauges 3.7 Awareness on setup criteria 3.8 Awareness on applicable Out of Control Action Plan (OCAP)	3.1 Read and interpret electrical diagrams 3.2 Apply procedures in electrical/ electronic manuals 3.3 Use proper tools for a specific task 3.4 Detect abnormality or non-conformance 3.5 Install electrical/ electronic parts on machine
4. Carryout machine parameters setting	4.1 Safety procedures are followed according to occupational safety and health (OSH) standards 4.2 Electrical/Electronic machine parameters are setup according to production specifications/work	4.1 Safety procedures and standards in machine parameters setting 4.2 Awareness on safety operation of production line machines 4.3 Electrical/Electronic machine parameters setup	4.1 Follow safety procedures 4.2 Set machine parameters 4.3 Read gauges

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	instructions 4.3 Electrical/Electronic machine parameters are checked according to production specifications/work instructions	4.4 Readings of different gauges 4.5 Awareness on setup criteria 4.6 Awareness on applicable Out of Control Action Plan (OCAP)	
5. Perform production setup buyoff	5.1 Safety procedures are followed according to occupational safety and health (OSH) standards 5.2 Outputs using dummy units, if applicable, are checked according to *product criteria* 5.3 Initial production outputs are checked according to product criteria 5.4 Completeness and accuracy of documents are checked in accordance to setup/conversion specifications	5.1 Safety procedures and standards in production setup buyoff 5.2 Knowledge in machine operations 5.3 Knowledge in product criteria 5.4 Understanding of data log results 5.5 Product handling 5.6 Documentation procedures 5.7 Awareness on applicable Out of Control Action Plan (OCAP)	5.1 Observe safety procedures 5.2 Operate machine being setup 5.3 Document data log results 5.4 Product handling

RANGE OF VARIABLES

VARIABLE	RANGE

1. Tools	Tools may include but not limited to:
	
	Mechanical
	  1.1 Set of Allen keys
	  1.2 Set wrenches
	  1.3 Tweezers
	  1.4 Torque driver
	  1.5 Level gauge
	  1.6 Steel rule/measuring tape
	  1.7 Puller
	  1.8 Hammer/mallet
	  1.9 Feeler gauge
	  1.10 Vernier/micrometer caliper
	  1.11 Peak tester
	
	Electrical
	  1.1 Set of screwdrivers
	  1.2 Set of pliers
	  1.3 Soldering iron
	  1.4 Crimper
	  1.5 Cutter
	  1.6 Electrical knife
	  1.7 *Cable ties*
	  1.8 *Electrical tape*

2. Equipment	Equipment may include but not limited to:
	  2.1 Laptop
	  2.2 Oscilloscope
	  2.3 VOM
	  2.4 Power meter
	  2.5 Temperature profile checker
	  2.6 Charge plate monitor
	  2.7 Infra-red (IR) camera
	  2.8 Vibration analyzer
	  2.9 Noise checker/ ultrasonic tester

3. Mechanical parts	May include but not limited to:
	  2.1. Pneumatic parts
	  2.2. Hydraulic parts
	  2.3. Pumps
	  2.4. Fabricated parts
	  2.5. OEM / Catalogue parts

4. Appropriate personnel	May include:
	  3.1 Manager
	  3.2 Engineer
	  3.3 Supervisor
	  3.4 Lead technician

5. Product criteria	4.1 Visual check
	  4.2 Physical check
	  4.3 Mechanical check
	  4.4 Electrical check
	  4.5 Dimension check
	  4.6 Function check

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate:
	1.1 Prepared tools, equipment and conversion kit
	1.2 Carried out machine mechanical setup/conversion
	1.3 Carried out machine electrical/electronic setup/ conversion
	1.4 Carried out machine parameters setting
	1.5 Performed production setup buyoff
2. Resource Implications	The following resources **MUST** be provided:
	2.1 Appropriate machine and equipment
	2.2 Tools (as indicated in the Range of Variables)
	2.3 Materials
	2.4 Work Instructions Assessment rating sheet
	2.5 Sample production checklist
	2.6 Applicable forms for specific equipment or machines
	2.7 Procedure and quality manuals
	2.8 Laptop
3. Methods of Assessment	Competency may be assessed through:
	3.1 Demonstration/Observation with oral questioning
	3.2 Written Test
4. Context for Assessment	4.1 Competency may be assessed in the work place or in a simulated work place setting

Note: For assessment - Behavioral indicator should be observed for each task being performed.

UNIT OF COMPETENCY: **MONITOR MACHINE PERFORMANCE**

UNIT CODE : **ELC724365**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes needed in monitoring machine performance. This includes gathering and analyzing basic machine data and performing/ recommending machine performance adjustment.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Gather machine data	1.1 Checklist and forms are prepared/ secured for machine data gathering 1.2 Performance log files/history are gathered from the machine based on manufacturing procedures 1.3 Machine data are gathered based on *key performance index* (KPI)	1.1 Knowledge in machine operations 1.2 Familiarity in machine functions. 1.3 Manufacturing procedures during machine production 1.4 Good understanding of Key Performance Index formulas 1.5 Basic Statistical Process Control (SPC) 1.6 7 Quality Control (QC) tools	1.1 Basic mathematical skills 1.2 Computer skills 1.3 Writing skills 1.4 Communication skills
2. Analyze basic machine data	2.1. Benchmark data are prepared based on machine standard registration 2.2. Gathered data are analyzed and compared against the set targets 2.3. Evaluation result is documented according to procedure or out-of-control action plan (OCAP) 2.4. KPI with non-conformance are identified and actions/ recommendations are determined based on manufacturer's procedures	2.1. Procedures/ Techniques in data analysis 2.2. Knowledge of appropriate evaluation tools 2.3. Knowledge in preparation of evaluation result and recommendation 2.4. Knowledge on machine standard registration settings	2.1. Processing, analysis and interpretation of data 2.2. Computer skills 2.3. Basic analytical skills 2.4. Troubleshooting skills 2.5. Documentation skills
3. Perform/ recommend machine adjustment	3.1 Safety procedures are followed according to occupational safety and health (OSH) standards 3.2 *Tools* are determined according to machine specifications 3.3 Machine *adjustment* is performed or recommended for any non-conformance against set standards	3.1 Occupational safety and health (OSH) standards for machine adjustment/ calibration 3.2 Knowledge in machine mechanical/electrical adjustment/calibration and parameter fine-tuning. 3.3 Knowledge in product criteria. 3.4 Knowledge in machine	3.1 Implement safety protocols 3.2 Set machine parameters. 3.3 Detect abnormality or non-conformance 3.4 Troubleshooting skills 3.5 Documentation skills

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ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
	3.4 Where necessary, approval is sought before machine adjustment or calibration based on company procedures 3.5 Machine adjustment or calibration is documented based on company procedures/work instructions	specifications and operation 3.5 Knowledge of out-of-control action plan (OCAP)	

RANGE OF VARIABLES

VARIABLE	RANGE

1. Tools	Tools may include but not limited to:
	Mechanical
	1.1 Set of Allen keys 1.11 Tachometer
	1.2 Set wrenches 1.12 Grease gun
	1.3 Set of screwdrivers 1.13 Air brush / gun
	    (standard) 1.14 Stop watch
	1.4 Set of jigs 1.15 Dial gauge
	1.5 Torque driver
	    (mechanical) Electrical/Electronics
	1.6 Level gauge 1.1 Set of screwdrivers
	1.7 Steel rule/measuring (electrical)
	    tape 1.2 Torque driver
	1.8 Hammer/mallet (electrical)
	1.9 Feeler gauge 1.3 Set of pliers
	1.10 Vernier/micrometer 1.4 VOM/DVM
	     caliper

2. Key performance index (KPI)	KPI may include but not limited to:
	2.1 Capacity
	2.2 Load time
	2.3 RPM (rate per minute)
	2.4 Output
	2.5 MTBF (mean time between failures)
	2.6 MTBA (mean time between assist)
	2.7 MTTA (mean time to assist)
	2.8 MTTR (mean time to repair)
	2.9 Overall equipment effectiveness
	    • availability/uptime
	    • efficiency/performance
	    • quality/yield

3. Adjustment	Machine adjustment may include: 3.1 Tightening of bolts and screws 3.2 Greasing and lubrication 3.3 Cleaning and air brushing 3.4 Parameter settings adjustment (e.g. speed, pressure, temperature) 3.5 Belt tensioning and tightening 3.6 Mechanical alignment 3.7 Sensor adjustment 3.8 Machine program adjustments (e.g. X-Y coordinates)

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Gathered machine data 1.2 Analyzed basic machine data 1.3 Performed/recommended machine adjustment
2. Resource Implications	The following resources **MUST** be provided: 2.1 Appropriate machine and equipment 2.2 Machine manual, if necessary 2.3 Tools (as indicated in the Range of Variables) 2.4 Materials 2.5 Work Instructions Assessment rating sheet 2.6 Sample production and/or maintenance checklist 2.7 Applicable forms for specific equipment or machines 2.8 Procedure and work instructions 2.9 Laptop
3. Methods of Assessment	Competency may be assessed through: 3.1 Demonstration/Observation with oral questioning 3.2 Written Test
4. Context for Assessment	4.1 Competency may be assessed in the work place or in a simulated work place setting

Note: For assessment - Behavioral indicator should be observed for each task being performed.

UNIT OF COMPETENCY: **PERFORM MACHINE TROUBLESHOOTING & REPAIR**

UNIT CODE : **ELC724366**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes needed in performing machine troubleshooting and repair. This includes preparing tools and/or instruments, carrying out machine mechanical/ electrical/ program troubleshooting, adjustment and repair and new parameter settings. This also includes test-running and monitoring the machine.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Prepare troubleshooting/ repair tools and/or instruments	1.1 Safety procedures are followed according to Occupational Safety and Health (OSH) Standards. 1.2 Appropriate **tools** and/or **instruments** are prepared to be used in the repair. 1.3 Tools and/or instruments are confirmed to be calibrated and in good condition.	1.1 Safety procedures and standards in machine settings and calibration 1.2 Familiarity with production line tools and/or instruments and their location 1.3 Understanding machine manuals, procedures, work instructions and other applicable documents/ specifications	1.1 Safety practice skills 1.2 Reading skills 1.3 Communication skills 1.4 Detect abnormality or non-conformance
2. Carry out machine mechanical/ electrical/ electronic/ program troubleshooting	2.1 Safety procedures are followed according to Occupational Safety and Health (OSH) Standards. 2.2 Machine troubles or symptoms are analyzed and probable source of problems are identified 2.3 Different **problem solving and analysis tools** are applied based on machine condition 2.4 Tests are conducted on suspected machine parts, units or modules based on machine standard condition 2.5 Defective machine/ electrical parts are identified and located using appropriate **troubleshooting methods** according to machine/ electrical troubleshooting manual.	2.1 Safety procedures and standards in mechanical/ electrical/ electronic troubleshooting 2.2 Machine troubles or symptoms 2.3 Machine troubleshooting methods 2.4 Knowledge in use of measuring instruments 2.5 Basic knowledge on electronic components 2.6 Basic PLC symbols, diagrams and sequences 2.7 Basic Motor control system 2.8 Sensor technology 2.9 Different problem solving and analysis tools	2.1 Troubleshooting skills 2.2 Reading and interpreting mechanical drawings and schematic diagrams 2.3 Applying problem solving and analysis tools

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
3. Carry out machine mechanical/ electrical/ program adjustment and repair	3.1 Safety procedures are followed according to Occupational Safety and Health (OSH) Standards. 3.2 ***Electromechanical*** or moving parts are aligned, adjusted or replaced when necessary to achieve standard machine conditions. 3.3 Electrical settings of machines are checked and adjusted to achieve standard machine conditions. 3.4 Specific instruments and/or tools are used to adjust the machine 3.5 Machine adjustment, calibration or parts replacement is documented based on company procedures	3.1 Safety procedures and standards in mechanical / electrical adjustments. 3.2 Familiarity with production line tools and/or equipment and their location. 3.3 Interpretation of mechanical drawings and electrical diagrams. 3.4 Knowledge in machine mechanical and electrical troubleshooting. 3.5 Knowledge on the use of setup jigs. 3.6 Understand machine mechanical / electrical parts and functions (especially moving parts). 3.7 Knowledge with basic pneumatic parts and systems. 3.8 Knowledge with basic hydraulic parts and system 3.9 Awareness on safety operation of production line machines. 3.10 Reading of different gauges. 3.11 Basic PLC symbols, diagrams and sequences 3.12 5S principles	3.1 Read and interpret mechanical drawings, schematic diagrams 3.2 Apply procedures in mechanical manuals 3.3 Use proper tools for a specific task 3.4 Detect abnormality or non-conformance 3.5 Remove/install mechanical parts on machine 3.6 Determine mechanical/ electrical parts function 3.7 Determine mechanical parts clearance based on standards
4. Carry out adjustment for new parameter settings	4.1 New machine parameters are set based on latest adjustment/ replacement. 4.2 Machine parts functionality based on new parameters is confirmed through manual mode 4.3 New machine parameters are saved on the machine memory 4.4 Machine parameter settings adjustment is documented based on company procedures	4.1 Safety procedures and standards in machine parameters setting 4.2 Awareness on safety operation of production line machines 4.3 Electrical/Electronic machine parameters setup 4.4 Readings of different gauges 4.5 Awareness on setup criteria	4.1 Following safety procedures 4.2 Setting machine parameters 4.3 Reading gauges 4.4

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
5. Test-run and monitor machine	5.1 Safety procedures are followed according to occupational safety and health (OSH) standards 5.2 Outputs using sample/dummy units, if necessary, are checked according to product criteria 5.3 Initial production outputs are checked according to product criteria 5.4 Completeness and accuracy of documents are checked in accordance to repair specifications 5.5 Machine is turned over for production in accordance with company procedures	5.1 Safety procedures and standards in machine troubleshooting and repair 5.2 Knowledge in machine operations 5.3 Knowledge in product criteria 5.4 Understanding of data log results 5.5 Product handling 5.6 Documentation procedures 5.7 Awareness on applicable Out of Control Action Plan (OCAP)	5.1 Observing safety procedures 5.2 Can operate machine being repaired 5.3 Document data log results 5.4 Product handling

RANGE OF VARIABLES

VARIABLE	RANGE	

1. Tools	Tools may include but not limited to:
	Mechanical
	  1.1 Set of Allen keys
	  1.2 Set wrenches
	  1.3 Tweezers
	  1.4 Torque driver
	  1.5 Level gauge
	  1.6 Steel rule/measuring tape
	  1.7 Puller
	  1.8 Hammer/mallet
	  1.9 Feeler gauge
	  1.10 Vernier/micrometer caliper
	  1.11 Peak tester
	  1.12 Grease gun
	  1.13 Air brush / gun
	  1.14 Stop watch
		Electrical (including accessories)
		  1.1 Set of screwdrivers
		  1.2 Set of pliers
		  1.3 Soldering iron
		  1.4 Crimper
		  1.5 Cutter
		  1.6 Electrical knife
		  1.7 Cable ties
		  1.8 Electrical tape
		  1.9 Soldering lead

2. Instruments	May include:
	  2.1 Oscilloscope
	  2.2 VOM/DVM
	  2.3 Power meter
	  2.4 Temperature profile checker
	  2.5 Charge plate monitor
	  2.6 Infra-red (IR) camera
	  2.7 Vibration analyzer
	  2.8 Noise checker/ ultrasonic tester
	  2.9 Clamp ammeter
	  2.10 Tachometer
	  2.11 Tension meter	

3. Problem solving and analysis tools	Problem solving and analysis tools may include:
	  3.1 Root cause analysis
	  3.2 5 Why analysis
	  3.3 Fish bone analysis
	  3.4 Equipment failure mode and effect analysis (EFMEA)	

4. Troubleshooting methods	Troubleshooting methods may include but not limited to:
	  4.1 Sensory method (sight, sound, touch, smell)
	  4.2 Substitution method/swapping
	  4.3 Signal injection and tracing
	  4.4 Voltage-current measurement
	  4.5 Continuity testing
	  4.6 Resistance check
	  4.7 Program/software diagnostics
	  4.8 Mechanical measurement (e.g clearance, planarity, height)	

5. Electromechanical parts	May include but not limited to:
	  5.1 Pneumatic parts
	  5.2 Hydraulic parts
	  5.3 Pumps	

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Prepared tools and/or instruments 1.2 Carried out machine mechanical/electrical troubleshooting 1.3 Carried out machine mechanical/ electrical adjustment and repair 1.4 Carried out new parameter setting 1.5 Test-run and monitored machine
2. Resource Implications	The following resources **MUST** be provided: 2.1 Appropriate machine and equipment 2.2 Tools (as indicated in the Range of Variables) 2.3 Materials 2.4 Work Instructions Assessment rating sheet 2.5 Sample production checklist 2.6 Applicable forms for specific equipment or machines 2.7 Procedure and quality manuals 2.8 Laptop
3. Methods of Assessment	Competency may be assessed through: 3.1 Demonstration/Observation with oral questioning 3.2 Written Test
4. Context for Assessment	4.1 Competency may be assessed in the work place or in a simulated work place setting

Note: For assessment - Behavioral indicator should be observed for each task being performed.

UNIT OF COMPETENCY: **PERFORM MACHINE PREVENTIVE MAINTENANCE AND CALIBRATION**

UNIT CODE   :   **ELC724367**

UNIT DESCRIPTOR   :   This unit covers the knowledge, skills and attitudes needed in performing machine preventive maintenance (PM). This includes preparing tools, instrument and machine, reviewing machine performance, carrying out machine preventive maintenance and calibration as well as buyoff machine condition after maintenance.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
1. Prepare maintenance and calibration tools, instrument and machine	1.1. Safety procedures are followed according to Occupational Safety and Health (OSH) Standards. 1.2. **Tools, jigs**, **instrument** and machine for PM are determined based from the Maintenance Procedures 1.3. Tools, instrument and machines are checked prior to the performance of the scheduled PM 1.4. Forms, check sheets, standards, spare parts (if applicable), **consumable parts** and **cleaning materials** are prepared for use in the preventive maintenance and calibration works	1.1. Safety procedures and standards in preventive maintenance of machines. 1.2. Familiarity with production line tools and/or equipment and their location. 1.3. Understanding machine manuals, procedures, work instructions and other applicable documents/ specifications 1.4. Knowledge in the use of various PM forms and check sheets 1.5. Knowledge on cleaning materials	1.1. Safety practice skills 1.2. Reading skills 1.3. Communication skills 1.4. Detecting abnormality or non-conformance
2. Assess machine performance/ condition	2.1 Previous PM activities and line performance are reviewed in accordance with company procedures. 2.2 Previous breakdown history is analyzed in accordance with machine maintenance manual 2.3 Appropriate action is determined based on the results of the review and analysis conducted. 2.4 Current machine performance/condition is assessed in accordance with user feedback.	2.1 PM standards and procedures 2.2 Machine preventive maintenance manuals 2.3 Knowledge in machine mechanical/ electrical adjustment/ calibration and parameter fine tuning 2.4 Knowledge in machine specifications and operation	2.1 Reading skills 2.2 Communication skills 2.3 Detecting abnormality or non-conformance
3. Carryout	3.1 Safety procedures are	3.1 Safety procedures	3.1 Read and

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables	REQUIRED KNOWLEDGE	REQUIRED SKILLS
machine preventive maintenance and calibration	followed according to occupational safety and health (OSH) standards 3.2 *Mechanical* and *electrical*/*electronic* parts are properly checked according to machine and product specifications and required maintenance time 3.3 PM check sheet items are executed in accordance with PM procedures and machine specifications 3.4 Calibration check sheet items are executed in accordance with calibration procedures and machine specifications 3.5 Any non-conformance to specifications is reported to *appropriate personnel*.	and standards in preventive maintenance and calibration 3.2 Familiarity with production line tools and/or equipment and their location. 3.3 Knowledge in machine mechanical and electrical preventive maintenance and calibration 3.4 Knowledge on the use of setup jigs. 3.5 Understand machine mechanical / electrical parts and functions (especially moving parts). 3.6 Knowledge with basic pneumatic parts and systems. 3.7 Knowledge with basic hydraulic parts and system 3.8 Awareness on safety operation of production line machines. 3.9 Reading of different gauges.	interpret mechanical drawings and electrical diagrams 3.2 Applying procedures in mechanical manuals 3.3 Can use proper tools for a specific task 3.4 Detecting abnormality or non-conformance 3.5 Can remove/ install mechanical parts on machine 3.6 Maintaining machine
4. Buyoff machine condition after maintenance	4.1 Safety procedures are followed according to occupational safety and health (OSH) standards 4.2 Outputs using dummy units are checked according to PM standards and product criteria 4.3 Initial machine performance and production outputs are monitored according to machine and product criteria 4.4 Completeness and accuracy of documents are checked in accordance to PM standards and procedures 4.5 Machine is turned over for production in accordance with company procedures	4.1 Safety procedures and standards in machine preventive maintenance and calibration 4.2 Knowledge in machine operations 4.3 Knowledge in machine and product criteria 4.4 PM standards and procedures 4.5 Understanding of PM analysis and results 4.6 Product handling 4.7 Awareness on applicable Out of Control Action Plan (OCAP)	4.1 Observing safety procedures 4.2 Can operate machine being maintained 4.3 Documentation skills 4.4 Communication skills 4.5 Product handling

RANGE OF VARIABLES

VARIABLE	RANGE	

1. Tools	May include but not limited to:
	Mechanical
	  1.1 Set of Allen keys
	  1.2 Set wrenches
	  1.3 Tweezers
	  1.4 Torque driver
	  1.5 Level gauge
	  1.6 Steel rule/measuring tape
	  1.7 Puller
	  1.8 Hammer/mallet
	  1.9 Feeler gauge
	  1.10 Vernier/micrometer caliper
	  1.11 Peak tester
	  1.12 Grease gun
	  1.13 Air brush / gun
	  1.14 Stop watch
		Electrical (including accessories)
		  1.10 Set of screwdrivers
		  1.11 Set of pliers
		  1.12 Soldering iron
		  1.13 Crimper
		  1.14 Cutter
		  1.15 Electrical knife
		  1.16 Cable ties
		  1.17 Electrical tape
		  1.18 Soldering lead

2. jigs	2.1 Measurement jigs Calibration jigs	

3. instrument	May include:
	  3.1 Oscilloscope
	  3.2 VOM/DVM
	  3.3 Power meter
	  3.4 Temperature profile checker
	  3.5 Charge plate monitor
	  3.6 Infra-red (IR) camera
		3.7 Vibration analyzer
		3.8 Noise checker/ ultrasonic tester
		3.9 Clamp ammeter
		3.10 Tachometer
		3.11 Tension meter

4. Consumable parts	4.1 Bolts, nuts and screws 4.2 Bushing 4.3 Linear bearing	4.4 Lubricants 4.5 Springs 4.6 Gaskets
5. Cleaning materials	5.1 Chemicals 5.2 Rags 5.3 Abrasives	
6. Mechanical parts	May include but not limited to: 6.1 Pneumatic parts 6.2 Hydraulic parts 6.3 Pumps 6.4 Fabricated parts 6.5 OEM / Catalogue parts	
7. Electronic parts	7.1 Switches 7.2 Sensors 7.3 Relays 7.4 Amplifiers 7.5 Vision systems (e.g camera)	
8. Appropriate personnel	May include: 8.1 Manager 8.2 Engineer 8.3 Supervisor 8.4 Lead technician	

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate:
	1.1 Prepared tools, instrument and machine
	1.2 Assessed machine performance/condition
	1.3 Carried out machine preventive maintenance and calibration
	1.4 Buyoff machine condition after maintenance
2. Resource Implications	The following resources **MUST** be provided:
	2.1 Appropriate machine and equipment
	2.2 Tools (as indicated in the Range of Variables)
	2.3 Materials
	2.4 Work Instructions Assessment rating sheet
	2.5 Sample PM checklist
	2.6 Applicable forms for specific equipment or machines
	2.7 Procedure and quality manuals
	2.8 Laptop
3. Methods of Assessment	Competency may be assessed through:
	3.1 Demonstration/Observation with oral questioning
	3.2 Written Test
4. Context for Assessment	4.1 Competency may be assessed in the work place or in a simulated work place setting

Note: For assessment - Behavioral indicator should be observed for each task being performed.

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 Electronics/Semiconductor Production Line Machine Servicing NC III.

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 :   Electronics/Semiconductor Production Line Machine Servicing
NC Level   :   NC III

Nominal Training Duration: 58 hrs – Basic Competencies
                                    52 hrs – Common Competencies
                                    464 hrs – Core Competencies
                                            [including 240 hrs – Supervised Industry
                                            Training (SIT)]
                                    ----
                                    574 hrs - Total

Course Description:

This course is designed to develop & enhance the knowledge, skills, & attitudes of an Electronics/Semiconductor Production Line Machine Technician, in accordance with industry standards. It covers the basic & common competencies in addition to the core competencies such as performing machine setup/conversion, monitoring machine performance, performing machine troubleshooting and repair as well as performing preventive maintenance and calibration.

To obtain this, all units prescribed for this qualification must be achieved:

BASIC COMPETENCIES
(58 hours)

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

1. Lead workplace communication	1.1 Communicate information about workplace processes	• Read
		  o Effective verbal communication methods
		  o Sources of information
			• Lecture	• Written Test	2 Hours

		• Practice organizing information	• Demonstration	• Observation	
		• Identify organization requirements for written and electronic communication methods	• Lecture	• Written Test	
		• Follow organization requirements for the use of written and electronic communication methods	• Demonstration • Practical exercises	• Observation	
		• Perform exercises on understanding and conveying intended meaning scenario	• Demonstration • Role Play	• Observation	

	1.2 Lead workplace discussions	• Describe:
		  o Organizational policy on production, quality and safety
		  o Goals/ objectives and action plan setting
			• Group discussion	• Oral evaluation	2 Hours

		• Read o Effective verbal communication methods	• Lecture	• Written Test	
		• Prepare/set action plans based on organizational goals and objectives	• Demonstration	• Observation	
	1.3 Identify and communicate issues arising in the workplace	• Describe: o Organizational policy in dealing with issues and problems	• Group discussion	• Oral evaluation	2 Hours
		• Read o Effective verbal communication methods	• Lecture	• Written Test	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
		• Practice organizing information	• Demonstration	• Observation	
		• Perform exercises on understanding and conveying intended meaning scenario	• Demonstration • Role Play	• Observation	
2. Lead small team	2.1 Provide team leadership	• Describe: o Company policies and procedures	• Group discussion	• Oral evaluation	2 Hours
		• Identify client expectations	• Lecture	• Written examination	
		• Practice team building skills	• Demonstration	• Observation	
		• Perform exercises on communication skills required for leading teams	• Demonstration • Role Play	• Observation	
	2.2 Assign responsibilities	• Describe: o Team member's duties and responsibilities	• Group discussion	• Oral evaluation	2 Hours
		• Identify client expectations	• Lecture	• Written examination	
		• Practice negotiating skills	• Demonstration	• Observation	
		• Perform group exercises showing the skills and techniques in promoting team building	• Demonstration • Role Play	• Observation	

	2.3 Set performance expectations for team members	• Describe:
		   o Team member's duties and responsibilities
		   o How performance expectations are set
			• Group discussion	• Oral evaluation	2 Hour

		• Identify client expectations	• Lecture	• Written examination	
		• Perform group exercises in setting individual target/ expectation	• Demonstration • Role Play	• Observation	
		• Read instruction and requirements in up to date dissemination to members	• Lecture	• Written examination	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
	2.4 Supervise team performance	• Describe listening and treating individual team members concern	• Group discussion	• Oral evaluation	2 Hour
		• Identify methods of Monitoring Performance	• Lecture	• Written examination	
		• Perform group exercises showing the skills in monitoring team performance	• Demonstration	• Observation	
3. Develop and practice negotiation skills	3.1 Identify relevant information in planning negotiations	• Describe: ○ codes of practice and guidelines for the organization ○ differences between content and process	• Group Discussion	• Oral evaluation	2 hours
		• Read: ○ Organizations policy and procedures for negotiations ○ Decision making and conflict resolution strategies procedures ○ Strategies to manage conflict ○ Steps in negotiating process	• Lecture • Lecture	• Written examination • Written examination	
		• Identify bargaining information	• Lecture	• Written examination	
		• Apply strategies to manage process • Apply steps in negotiating process	• Demonstration	• Observation	
	3.2 Participate in negotiations	• Describe the following strategies during negotiation: ○ Decision making and conflict resolution strategies procedures ○ Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation	• Group Discussion • Case studies	• Oral evaluation	2 Hours

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

		• Practice the following scenarios in a group activity:
		  o Perform interpersonal skills to develop rapport with other parties
		  o Perform verbal communication and listening skill
		  o observation skills
		  o negotiation skills
			• Demonstration
			• Simulation/ Role play
				• Observation	

	3.3 Document areas for agreement	• Describe the Procedure in documenting negotiations	• Group Discussion • Simulation/ Role play	• Oral evaluation	2 Hours
		• Apply a filing system in managing information	• Demonstration	• Observation	
		• Demonstrate filing of documents			
4. Solve workplace problems related to work activities	4.1 Identify the problem	• Describe Normal operating parameters & product quality	• Group discussion	• Oral evaluation	2 Hours
		• Identify & clarify the nature of problem	• Lecture	• Written examination	

		• Read:
		  o Brainstorming
		  o Cause and effect diagrams
		  o PARETO analysis
		  o SWOT analysis
		  o GANT chart
		  o PERT CPM & graph
		  o SCATTERGRAMS
			• Lecture	• Written examination	

		• Apply observation, investigation and analytical techniques in solving problem in the workplace	• Demonstration	• Observation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
	4.2 Determine fundamental cause of the problem	• Describe Teamwork and work allocation problem	• Group discussion	• Oral evaluation	2 Hours

		• Read:
		  o Using range of formal problem solving techniques
		  o Enterprise goals, targets and measures
		  o Enterprise quality, OHS and environmental requirement
		  o Non-routine process and quality problems
			• Lecture	• Written examination	

		• Perform group exercises showing safety in emergency situations and incidents	• Demonstration • Role Play	• Observation	
		• Identify & clarify the nature of problem	• Lecture	• Written examination	
		• Select relevant equipment and operational processes	• Lecture	• Written examination	
	4.3 Determine correct / preventive action	• Describe principles of decision making strategies and techniques	• Group Discussion	• Oral evaluation	1 Hour

		• Read:
		  o Evaluating the solution
		  o Devising the best solution
			• Lecture	• Written examination	

		• Perform group exercise how to implement the developed plan to rectify a problem	• Demonstration • Role Play	• Observation	
	4.4 Provide recommendation to manager	• Describe industry codes and standards	• Group Discussion	• Oral evaluation	1 Hour
		• Apply enterprise information systems and data collation • Prepare recommendation letter	• Demonstration	• Observation	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
5. Use mathematical concepts and techniques	5.1 Identify mathematical tools and techniques to solve problems	• Describe the four fundamental operation (addition, subtraction, division, multiplication)	• Group Discussion	• Oral evaluation	2 Hour

		• Read:
		  o Measurement system
		  o Precision and accuracy
		  o Basic measuring tools/devices
			• Lecture	• Written examination	

		• Apply mathematical computations	• Demonstration	• Observation	

		• Demonstrate activities on:
		  o Use of calculator
		  o Use of different measuring tools
			• Demonstration	• Observation	

	5.2 Apply mathematical procedures / solution	• Read:
		  o Estimation
		  o Problem-based questions
		  o Mathematical techniques
			• Lecture	• Written examination	2 Hours

		• Apply mathematical computations	• Demonstration • Simulation/ Role play	• Observation	

		• Demonstrate activities on:
		  o Use of calculator
		  o Use of different measuring tools
		  o Use of mathematical tools and standard formulas
			• Demonstration	• Observation	

	5.3 Analyze results	• Describe the four fundamental operation (addition, subtraction, division, multiplication)	• Group Discussion	• Oral evaluation	2 Hours

		• Read:
		  o Measurement system
		  o Precision and accuracy
		  o Basic measuring tools/devices
			• Lecture	• Written examination	

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
		• Apply mathematical computations	• Demonstration	• Observation	

		• Demonstrate activities on:
		  o Use of calculator
		  o Use of different measuring tools
			• Demonstration	• Observation	

6. Use relevant technologies	6.1 Identify appropriate technology	• Describe company policy in relation to relevant technology	• Group Discussion	• Oral evaluation	2 Hour

		• Read:
		  o Awareness on technology and its function
		  o Relevant technology application/ implementation
		  o Operating instructions
			• Lecture	• Written examination	

		• Practice basic communication skill in a group activity	• Demonstration • Simulation/ Role Play	• Observation	
	6.2 Apply relevant technology	• Describe different management concepts	• Group Discussion	• Oral evaluation	2 Hours

		• Read:
		  o Relevant technology application/ implementation
		  o Technology adaptability
		  o Different management concepts
		  o Health and safety procedure
		  o Communication techniques
			• Lecture	• Written examination	

		• Apply software applications skills	• Demonstration	• Observation	
		• Practice drills on installing application software	• Demonstration	• Observation	
		• Practice basic communication skill in a group activity	• Simulation/ Role Play		

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
	6.3 Maintenance / enhance relevant technology	• Read: o Repair and maintenance procedure	• Lecture	• Written examination	2 Hours
		o Operating instructions	• Lecture	• Written examination	

		• Practice drills:
		  o installing application software
		  o Basic troubleshooting skills
			• Demonstration
			• Simulation/ Role Play
				• Observation	

7. Apply critical thinking and problem solving techniques in the workplace	7.1. Identify the problem	• Lecture and discussion on
		  o Processes, normal operating parameters, and product quality to recognize nonstandard situations
		  o Enterprise goals, targets and measures
		  o Analytical techniques
		  o Types of problems
			• Lecture
			• Group Discussion
				• Oral evaluation
				• Written Examination
					2 Hours

	7.2. Determine fundamental causes of the problem	• Lecture and collaboration on
		  o Root cause of the problem
		  o Problem solving tools
		• Exercise on cause and effect
			• Lecture
			• Group Discussion
				• Oral evaluation
				• Written Examination
				• Observation
					2 Hours

	7.3. Determine corrective action	• Lecture and discussion on
		  o Identification and analysis of possible options for problem resolution
		  o Corrective actions
		  o Principles of decision making strategies and techniques
		• Layouting of action plans
			• Lecture
			• Group Discussion
				• Oral evaluation
				• Written Examination
				• Observation
					2 Hours

	7.4. Provide recommendation/s to manager	• Using range of formal problem solving techniques • Preparation and presentation of sample recommendation report	• Lecture • Group Discussion	• Oral evaluation • Written Examination • Presentation	2 Hours

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

8. Evaluate current sustainable development exercises in the workplace	8.1. Investigate current practices in relation to resource usage	• Lecture and discussion on
		  o Environmental regulations applying to the enterprise
		  o Procedures for assessing compliance with environmental regulations
		  o Analysis and recording of current purchasing strategies
		  o Analysis of current work processes to access information and data
		• Collection of information on environmental and resource efficiency systems and procedures
		• Measurement and recording of current resource usage
		• Identification of areas for improvement
			• Lecture
			• Group Discussion
				• Oral evaluation
				• Written Examination
					4 Hours

	8.2. Set targets for improvements	• Lecture and discussion on
		  o Inputs from stakeholders, key personnel and specialist
		  o Procedures to access to external sources of information and data
		  o Methods of setting efficiency targets
		• Evaluation of alternative solutions to workplace environmental issues
			• Lecture
			• Group Discussion
				• Oral evaluation
				• Written Examination
				• Observation
					2 Hours

	8.3. Implement performance improvement strategies	• Lecture and discussion on
		  o Sources of techniques/tools
		  o Application of continuous improvement strategies
		  o Ideas and possible solutions to the work group and management
		  o Methods of seeking suggestions
			• Lecture
			• Group Discussion
				• Oral evaluation
				• Written Examination
				• Observation
				• Presentation
					4 Hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodology	Assessment Approach	Nominal Duration
		and ideas about environmental and resource efficiency management from stakeholders ○ Action taken for the collected suggestion and ideas • Integration and implementation of environmental and resource efficiency improvement plans • Implementation of costing strategies to fully value environmental assets			
	8.4. Monitor performance	• Lecture and discussion on: ○ Evaluation and monitoring of tools and technology ○ Documentation of outcomes and communicate reports ○ Evaluation of strategies ○ Setting of new targets ○ Investigation and application of new tools and strategies ○ Promotion of successful strategies ○ Compensation through reward giving to participants • Set new targets based on evaluation strategies • Identify and prepare promotion strategies	• Lecture • Group Discussion	• Oral evaluation • Written Examination • Observation • Presentation	2 Hours

Note: Basic competencies may be embedded in the core competencies.

COMMON COMPETENCIES
(52 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

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
2. Perform Mensuration 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

	2.2 Carry-out measurements and calculations	▪ Read
		  a. Measurements
		    o Linear measurement
		    o Geometrical measurement
		  b. Trade Mathematics
		    o Unit conversion
		    o Ratio and proportion
		    o 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

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

	3.2 Interpret technical drawing	▪ Interpret blueprint reading and plan specification
		  o Electronics symbols and abbreviations
		  o Drawing standard symbols
		
		▪ Read:
		  a. Trade Theory
		    o Types of electronics/ semiconductors product plans
		    o Notes and specifications
		  b. Trade mathematics
		    o Linear measurement
		    o Dimension
		    o Unit convention
		
		▪ Match specification details with existing resources
			▪ Lecture
			▪ Demonstration
			▪ Group discussion
			▪ Basic technical drafting activity
				▪ Written examination
				▪ Oral evaluation
				▪ Drafting technical drawings and plans
					2 hours

	3.3 Prepare/ make changes to electrical/ electronic schematics and drawings	▪ Read
		  o Freehand sketching techniques
		  o Pictorial drawing
		  o Drawing conventions
		  o Dimensioning conventions
		
		▪ Apply mathematics
		  o Four fundamental operations
		  o Percentage
		  o Fraction
		  o Algebra
		  o 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

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

	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
		  o Storing drawing in digital forms, i.e. Scanner, CAD
		  o Handling and storing of drawings
		  o 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 ▪ Identify faulty materials ▪ Check quality of materials or component parts as per manufacturer's standards ▪ Interpret specifications or symbols	▪ Lecture ▪ Field trip ▪ Symposium ▪ Video clips ▪ Simulation/ Role playing	▪ Written test ▪ Demonstration & questioning ▪ Observation & questioning	3 hours
	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

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
5. Perform Computer Operation	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	▪ Demonstration & questioning ▪ Observation & questioning	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	▪ Demonstration & questioning ▪ Assessment of output product ▪ Computer-based assessment	1 hour

	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
				▪ Demonstration & questioning
				▪ observation
				▪ Computer-based assessment
					2 hour

	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
				▪ Demonstration & questioning
				▪ Observation & questioning
				▪ Computer-based assessment
					1 hour

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

	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)
				▪ Demonstration & questioning
				▪ Third party report
				▪ Assessment of output product
				▪ Portfolio
					2 hours

6. Terminate and Connect Electrical wiring and Electronic Circuit	6.1 Plan and prepare for termination/ connection of electrical wiring/ electronics circuits	▪ Read and familiarize
		  o Use of hand tools and test instruments / equipment
		  o Basic Electrical theory and application
		  o OH & S guidelines and procedures
		  o Basic electrical and electronic devices
		▪ Prepare hand tools and test equipment for termination
		▪ Prepare electrical/ electronic materials for termination
			▪ Film Viewing
			▪ Individualized Learning
			▪ Direct Student Laboratory Experience
			▪ On the Job Training
			▪ Project Method
				▪ Demonstration and Questioning
				▪ Assessment of Output Product
					1 hour

	6.2 Terminate/ connect electrical wirings/ electronic circuits	▪ Learn and apply
		  a. Electrical wirings
		    o Wiring techniques
		    o OH & S principles
		    o Specifications and methods for terminating different materials
		  b. Electronics circuits
		    o Soldering techniques and procedures
		    o OH & S principles
		    o Surface mount soldering techniques
		    • Use of lead-free soldering technology
		▪ Perform different types of splices
		▪ Perform soldering techniques and procedures
			▪ Film Viewing
			▪ Individualized Learning
			▪ Direct Student Laboratory Experience
			▪ On the Job Training
			▪ Project Method
				▪ Demonstration and Questioning
				▪ Assessment of Output Product
					3 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	6.3 Test termination/ connections of electrical wiring/ electronics circuits	▪ Read and familiarize a. AC and DC power supplies b. Use of diagnostic equipment c. Surface mount soldering techniques d. Tests for wiring and connections e. Wiring support techniques and alternatives ▪ Practice soldering techniques ▪ Practice printed circuit board repair and techniques ▪ Apply electronic assembly functional and quality testing ▪ Perform testing of wiring and connections for conformance to specification ▪ Use language and literacy skills to complete short reports and required ▪ Adjust and fix wiring supports	▪ Film Viewing ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ On the Job Training ▪ Project Method	▪ Demonstration and Questioning ▪ Assessment of Output Product	1 hour

7. Test electronic components	7.1 Determine criteria for testing electronics components	▪ Determine work safety requirements and economy of materials with durability
		▪ Familiarize Testing Criteria:
		  o controls
		  o effectiveness
		  o efficiency
		  o bug detection
		  o functionality, including flow
		  o interoperability
		  o performance
		  o reliability
		  o operating parameters
		
		▪ Apply testing criteria for electronics components
			▪ Film Viewing
			▪ Individualized Learning
			▪ Direct Student Laboratory Experience
			▪ On the Job Training
			▪ Project Method
				▪ Demonstration and Questioning
				▪ Assessment of Output Product
					1 hours

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

	7.2 Plan an approach for component testing	▪ Read and familiarize
		  o 5S application and observation of required timeframe
		  o Work Safety requirements and economy of materials with durability
		  o Various testing methods
		  o Types of electronic components
		
		▪ Observe proper use of VOM/DMM
		▪ Observe OH&S principles
		▪ Identify electronics components
		▪ Identify testing methods
			▪ Film Viewing
			▪ Individualized Learning
			▪ Direct Student Laboratory Experience
			▪ On the Job Training
			▪ Project Method
				▪ Demonstration and Questioning
				▪ Assessment of Output Product
					1 hours

	7.3 Test components	▪ Study materials, tools and equipment uses and specifications
		  o Proper care and use of tools
		▪ Familiarize types of electronic components
		  o Passive components
		  o Active components
		  o Dynamic components
		  o Hybrid components
		▪ Learn testing methods
		  o automated
		  o debugging
		  o inspection
		  o platform testing
		  o prototyping
		▪ Measure capacitance and resistance using VOM/ DMM
		▪ Determine testing procedures for electronics components
		▪ Identify electronics component parts
		▪ Apply proper use of testing instruments
			▪ Film Viewing
			▪ Individualized Learning
			▪ Direct Student Laboratory Experience
			▪ On the Job Training
			▪ Project Method
				▪ Demonstration and Questioning
				▪ Assessment of Output Product
					3 hours

Unit of Competency	Learning Outcomes	Learning Activities	Methodologies	Assessment Approach	Nominal Duration
	7.4 Evaluate the testing process	- Study the evaluation of testing process and records system - Study 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 - Perform data evaluation and records - Evaluate functionality and operation of electronic system	- Film Viewing - Individualized Learning - Direct Student Laboratory Experience - On the Job Training - Project Method	- Demonstration and Questioning - Assessment of Output Product	2 hours

CORE COMPETENCIES
464 hrs. (224 hrs. in-school + 240 hrs SIT*)

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration

1. Perform machine setup/ conversion
 	
(52 hrs)
	1.1 Prepare setup tools, equipment and conversion kits	• Identification of different production line tools, equipment and conversion kits and their functions and location
		• Familiarization of machine setup and conversion
		• Familiarization of machine manuals, work instructions/ procedures and other applicable documents/ specifications
		• Discussion on safe handling of tools and materials
		• Introduction on:
		  o 5S principles
		  o Occupational Health and Safety (OHS)
		  o Material Safety Data Sheet (MSDS)
		  o Personal Protective Equipment (PPE)
		  o Electro Static Discharge (ESD)
		  o Environmental Health Systems (EHS)
		  o Cleanroom requirements and contamination control
		  o IPC standards
		  o Quality Management System
		  o Environmental Management System
			• Select and check tools, equipment and conversion kits
			• Proper handling and transport of tools, equipment and conversion kits
				• Lecture
				• Discussion
				• Hands-on/ Demonstration
				• Viewing multimedia
					• Written exam
					• Practical exam
					• Interviews/ questioning
						8 hours

				• Supervised Industry Training (SIT)		8 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration
	1.2 Carryout machine mechanical setup/ conversion	• Familiarization of machine mechanical assemblies, functions and parts • Familiarization of machine safety features specifically on moving parts • Familiarization of machine setup and operating procedures through available manuals and specifications • Identification of various mechanical conversion kits • Orientation on measurement systems (English/Metric) • Introduction to: ○ use of setup jigs ○ machine mechanical parts and functions (especially moving parts) ○ basic pneumatic parts and system ○ basic hydraulic parts and system	• Install/Replace conversion kits/parts • Perform mechanical adjustment on machine parts and assemblies • Read of different gauges and use of measuring tools	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	24 hours
				• Supervised Industry Training (SIT)		24 hours
	1.3 Carryout machine electrical/ electronic setup/ conversion	• Familiarization of machine electronic/electrical assemblies, functions and parts • Familiarization of machine electrical/electronic parts and electrical safety standards • Familiarization of machine electrical/electronic setup and operating procedures through available manuals and	• Install/Replace machine electrical/ electronic parts • Perform electrical/ electronic adjustment or configuration • Read different measuring instruments • Interpretation of electrical diagrams	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	12 hours
				• Supervised Industry Training (SIT)		24 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration

		specifications
		• Identification of various machine electrical conversion kits
		• Orientation on measurement systems (English/Metric)
		• Introduction to:
		  o Electrical diagrams
		  o Machine electrical/ electronic parts and functions
		  o Electrical/electronic parts setup criteria				

	1.4 Carryout machine parameters setting	• Familiarization on safety procedures and standards in machine parameters setting • Familiarization of machine parameters setup and operating procedures through available manuals and specifications • Accessing the machine user interface • Orientation on machine software parameters • Orientation on applicable machine operating systems	• Set machine parameters	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	4 hours
				• Supervised Industry Training (SIT)		16 hours
	1.5 Perform production setup buyoff	• Familiarization on safety procedures and standards in production setup buyoff • Orientation on product handling • Familiarization on product criteria • Orientation on product acceptance criteria • Confirmation of setup checklist	• Check dummy units outputs • Check initial production outputs • Perform data recording and documentation	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	4 hours
				• Supervised Industry Training (SIT)		8 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration

2. Monitor machine performance
 	
(32 hrs)
	2.1 Gather machine data	• Familiarization on machine functions and operations
		• Introduction on:
		  o Manufacturing procedures during machine production
		  o Basic Statistical Process Control (SPC)
		  o 7 Quality Control (QC) tools
		• Statistical information on machine output
		• Introduction of key performance index (KPI)
		  o capacity
		  o load time
		  o RPM (rate per minute)
		  o Output
		  o MTBF
		  o MTBA
		  o MTTR
		  o Overall equipment effectiveness
		    − availability/uptime
		    − efficiency/performance
		    − quality/yield
			• Prepare checklist and forms
			• Gather machine data
				• Lecture
				• Discussion
				• Demonstration
				• Viewing multimedia
					• Written exam
					• Practical exam
					• Observation in workplace
					• Interviews/ questioning
						24 hours

				• Supervised Industry Training (SIT)		16 hours
	2.2 Analyze basic machine data	• Procedures/Techniques in data investigation and trouble shooting • Application of 7 QC tools o Types of graphs, diagrams and charts • Familiarization of machine standard registration settings	• Preparation of benchmark or baseline data • Presentation and interpretation of machine data • Perform documentation on evaluation result	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	4 hours
				• Supervised Industry Training (SIT)		16 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration

	2.3 Perform/ Recommend machine adjustment.	• Familiarization on occupational safety and health (OSH) standards for machine adjustment/ calibration
		
		• Identification of non-conformities and equivalent out-of-control action plan (OCAP)
		
		• Machine adjustments
		  o Electronic/Electrical
		  o Mechanical
		  o Software
			• Review and perform adjustment of machine parameters
			
			• Evaluate KPI after adjustment was made
				• Lecture
				• Discussion
				• Demonstration
				• Viewing multimedia
					• Written exam
					• Practical exam
					• Observation in workplace
					• Interviews/ questioning
						4 hours

				• Supervised Industry Training (SIT)		8 hours

3. Perform machine troubleshooting and repair
 	
(80 hrs)
	3.1 Prepare troubleshooting/ repair tools and/or instruments	• Familiarization with troubleshooting tools and/or instruments and their location
		
		• Discussion on safe handling of troubleshooting/repair tools and materials
		
		• Understanding of machine manuals, procedures, diagrams, work instructions and other applicable documents/ specifications
		
		• Introduction on:
		  o 5S principles
		  o Occupational Health and Safety (OHS)
		  o Material Safety Data Sheet (MSDS)
		  o Personal Protective Equipment (PPE)
		  o Electro Static Discharge (ESD)
		  o Environmental Health Systems (EHS)
			• Select and check troubleshooting/repair tools, instruments and spare parts
			
			• Proper handling and transport of troubleshooting/repair tools, instruments and spare parts
				• Lecture
				• Discussion
				• Demonstration
				• Viewing multimedia
					• Written exam
					• Practical exam
					• Observation in workplace
					• Interviews/ questioning
						8 hours

				• Supervised Industry Training (SIT)		8 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration
		o Cleanroom requirements and contamination control o IPC standards o Quality Management System o Environmental Management System				
	3.2 Carry out machine mechanical/ electrical/ program troubleshooting	• Safety procedures and standards in mechanical / electrical troubleshooting • Distinction of normal and abnormal machine condition • Identification of machine troubles or symptoms • Different machine troubleshooting methods and techniques • Uses and functions of measuring instruments • Introduction to motor control system • Introduction to Sensor technology • Distinction of normal and abnormal machine condition	• Troubleshoot machine troubles or symptoms • Perform measurement and validation of machine parameters • Test machine parts, units or modules • Read and interpret basic PLC symbols, diagrams and sequences • Check motor control system	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	40 hours
				• Supervised Industry Training (SIT)		24 hours
	3.3 Carry out machine mechanical/ electrical adjustment and repair	• Safety procedures and standards in mechanical / electrical adjustments. • Use of setup and adjustment jigs. • Adjustment/replacement of defective pneumatic parts and systems. • Adjustment of hydraulic parts and systems • Machine adjustments or replacement	• Perform Machine adjustments or replacement o Electronic/Electrical – Boards, sensors, relays, fuses, switches, etc. o Mechanical – Timing belt, gears, screws, alignments,	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	24 hours
				• Supervised Industry Training (SIT)		24 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration

		o Electronic/Electrical
		  − Boards, sensors, relays, fuses, switches, etc.
		  − Motor control
		o Mechanical
		  − Timing belt, gears, screws, alignments, fluids/lubricants, cooling and heating system, etc.
		  − Pneumatic and hydraulic system
		o Software
		  − Parameters, programs, settings, etc.
		• Readings of different gauges.
			fluids/lubricants, cooling and heating system, etc.
			o Software
			  − Parameters, programs, settings, etc.
			• Check completeness of repaired assembly
			  • Completeness of screws, fasteners, harnessing, etc.
			• Apply 5S principles			

	3.4 Carry out new parameter settings	• Safety procedures and standards in machine parameters setting • Electrical/Electronic machine parameters setup • Machine setup criteria	• set new machine parameters	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	4 hours
				• Supervised Industry Training (SIT)		16 hours
	3.5 Test-run and monitor machine	• Machine safety features and standards • Product and machine acceptance criteria • Familiarization of data log results • Proper product handling • Documentation procedures	• Activate machine safety features • Test-run the machine • Checking initial product outputs • Validate machine data • Update machine records • Turn-over machine to production	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	4 hours
				• Supervised Industry Training (SIT)		8 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration
4. Perform Machine Preventive Maintenance and Calibration **(60 hrs)**	4.1. Prepare maintenance and calibration tools, instrument and machine	• Safety procedures and standards in preventive maintenance of machines. • Familiarization of maintenance and calibration tools, instrument and machine • Understand machine manuals, preventive maintenance and calibration procedures, work instructions and other applicable documents/ specifications. • Uses of various PM forms and check sheets	• Prepare preventive maintenance and calibration tools, instruments and replacement parts • Proper handling of tools, instruments and machine replacement parts • Prepare forms and check sheets	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	8 hours
				• Supervised Industry Training (SIT)		8 hours
	4.2. Assess machine performance/ condition	• Preventive maintenance standards and procedures • Machine preventive maintenance manuals • Machine mechanical/ electrical adjustment/ calibration and parameter fine tuning • Machine specifications and operation	• Review adjustment/ calibration and parameter fine tuning of the machine • Review machine operation performance	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	4 hours
				• Supervised Industry Training (SIT)		8 hours
	4.3. Carryout machine preventive maintenance and calibration	• Safety procedures and standards in preventive maintenance and calibration • Mechanical and electronic machine parts • Preventive Maintenance check sheet items • Preventive Maintenance procedures and machine specifications • Calibration procedures • Mechanical drawings and	• Perform parts replacement using mechanical drawings and electrical diagrams as reference • Tag and label machine parts • Carry-out PM and calibration to meet acceptance criteria	• Lecture • Discussion • Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	40 hours
				• Supervised Industry Training (SIT)		16 hours

Unit of Competency	Learning Outcomes	Learning Contents	Practical Activities	Methodologies	Assessment Methods	Nominal Duration
		electrical diagrams interpretation • Calibration and diagnostic instruments				
	4.4. Buyoff machine condition after maintenance	• Machine safety features and standards • Product and machine acceptance criteria • Familiarization of data log results • Proper product handling • Documentation procedures	• Activate machine safety features • Perform machine buyoff • Checking initial product outputs • Validate machine data • Update machine records • Turn-over machine to production	• Lecture • Discussion • Hands-on/ Demonstration • Viewing multimedia	• Written exam • Practical exam • Observation in workplace • Interviews/ questioning	8 hours
				• Supervised Industry Training (SIT)		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) 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;

   - Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, audio, video, computer technologies or other modern technology that can be used to facilitate learning and formal and non-formal training. Specific guidelines on this mode shall be issued by the TESDA Secretariat.

   - 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:

- 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.

- Informal Apprenticeship - is based on a training (and working) agreement between an apprentice and a master craftsperson wherein the agreement may be written or oral and the master craftsperson commits to training the apprentice in all the skills relevant to his or her trade over a significant period of time, usually between one and four years, while the apprentice commits to contributing productively to the work of the business. Training is integrated into the production process and apprentices learn by working alongside the experienced craftsperson.

- 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.

2.3. Community-Based:

- Community-Based Training – short term programs conducted by non-government organizations (NGOs), LGUs, training centers and other TVET providers which are intended to address the specific needs of a community. Such programs can be conducted in informal settings such as barangay hall, basketball courts, etc. These programs can also be mobile training program (MTP).

3.3   TRAINEE ENTRY REQUIREMENTS

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

- Must have any of the following requirement:
  o be at least a graduate of 2-yrs. Technical course related in electronics, electrical and/or mechanical area
  o have at least 2-yrs. relevant industry work experience in electronics, semiconductor, electrical and/or mechanical manufacturing area
- Able to communicate orally & in writing both in English and Pilipino
- Able to perform basic mathematical computations

This list does not include specific institutional requirements, such as height and age requirements, educational attainment, appropriate work experience and others that may be required from 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 Electronics/Semiconductor Production Line Machine Servicing NC III:

TOOLS		EQUIPMENT		MATERIAL	
Qty.	Description	Qty.	Description	Qty.	Description
Mechanical tools				**Mechanical parts**	
25 set	Allen keys	5 units	Laptop	1 lot	Pneumatic parts
25 set	Wrenches	1 unit	Oscilloscope	1 lot	Hydraulic parts
25 pcs	Tweezers	1 unit	Power meter	1 lot	Pumps
5 pcs	Torque driver	5 units	Tachometer	1 lot	Fabricated parts
5 pcs	Level gauge	1 unit	Temperature profile checker	1 lot	OEM/Catalogue parts
5 pcs	Grease gun	1 unit	Charge plate monitor		
5 pcs	Puller	1 unit	Infra-red (IR) camera	**Electronic parts**	
5 pcs	Hammer/mallet	1 unit	Vibration analyzer	1 lot	Switches
5 pcs	Vernier/ micrometer caliper	1 unit	Noise checker/ ultrasonic tester	1 lot	Sensors
5 pcs	Filler gauge	5 units	Tension meter	1 lot	Relays
5 pcs	Peak tester	5 units	Clamp ammeter	1 lot	Amplifiers
5 set	jigs	1 set	PLC training module	1 lot	fuses
25 pcs	Steel rule/ measuring tape	1 set	Pneumatic training module	**Consumable parts**	
5 pcs	Air brush/gun	1 set	Hydraulic training module	1 lot	Bolts, nuts and screws
5 pcs	Stop watch	1 unit	compressor	1 lot	Bushings
		As prescribed	Electronics/Semi-conductor production line equipment*	1 lot	Linear bearings
Electrical tools		**PPE**		1 lot	Grounding wires
25 set	Screwdrivers	25 pcs.	Safety helmet	1 lot	Lubricants
25 set	Pliers	25 pairs	Safety shoes	1 lot	Springs
25 pcs	Soldering iron and lead	25 pcs.	Safety glasses/ goggles	1 lot	gaskets
5 pcs	Crimper	25 pcs.	Safety harness	1 lot	Cable ties
25 pcs	Cutter	25 pcs.	Ear plugs/ear muffs	25 rolls	Electrical tape
25 pcs	Electrical knife	25 pcs.	Gas mask.	1 lot	Terminal plugs
5 pcs	VOM / DVM	25 pairs	Cotton gloves		

* TVET provider may tie up with electronics/semiconductor manufacturing firm/s to have access to the prescribed equipment through a Memorandum of Agreement (MOA).

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/Production 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	2 x 2	4	2	8
Total				128
Facilities / Equipment / Circulation**				38
Total Area				**162**

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

NOTE: *Access to and use of equipment /facilities can be provided through company/ enterprise arrangements or MOA with other partner- electronics/semiconductor plants/companies.*

3.6 TRAINER'S QUALIFICATIONS

Electronics/Semiconductor Production Line Machine Servicing NC III

- Be a holder of NTTC I in Electronics/Semiconductor Production Line Machine Servicing NC III;
- Must have at least two (2) years relevant industry experience in the current field of machine servicing.

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 institutional assessment is administered by the trainer/assessor.

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 a full qualification or 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 **Electronics/Semiconductor Production Line Machine Servicing NC III**, the candidate must demonstrate competence in all the units listed in Section 1. Successful candidates shall be awarded a **National Certificate III** signed by the TESDA Director General.

4.1.2. The qualification of **Electronics/Semiconductor Production Line Machine Servicing NC III** may be attained through demonstration of competence through project-type assessment covering all the units 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. Individuals wanting to be certified will have to be assessed in accordance with the requirements identified in the relevant unit/s of competency.

4.1.5. Recognition of Prior Learning (RPL). Candidates who have gained competencies through informal training, previous work or life experiences may apply for recognition in a particular qualification through a recognition/ assessment process.

4.1.6. The industry shall determine assessment and certification requirements for each qualification with promulgated Training Regulations. These include the following:
   a. entry requirements for candidates
   b. evidence gathering methods
   c. qualification requirements of competency assessors
   d. specific assessment and certification arrangements

4.1.7. The guidelines on assessment and certification are discussed in detail in the "Operating Procedures 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 manage the assessment activities of candidates for national certification.

4.2.3   **Accredited Competency Assessor**. Only competency assessor accredited by TESDA is authorized 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 performs 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 is 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

19) **Resource Implication -** refer 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

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

21) **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 serves 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

22) **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

23) **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

24) **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) **Cleanroom** or **clean room** is an environment, typically used in manufacturing or scientific research, with a low level of environmental pollutants such as dust, airborne microbes, aerosol particles, and chemical vapors. More accurately, a cleanroom has a **controlled** level of contamination that is specified by the number of particles per cubic meter at a specified particle size.

2) **Electronic manufacturing services** (**EMS**) is a term used for companies that design, test, manufacture, distribute, and provide return/repair services for electronic components and assemblies for original equipment manufacturers (OEMs). The concept is also referred to as electronic contract manufacturing (ECM).

3) **Electrostatic discharge (ESD**) is a swift discharge of electric current between two objects with different charges and different numbers of electrons. This exchange of electrons creates a large electromagnetic field buildup, resulting in ESD. Certain electronic devices are vulnerable to low-voltage ESD. For example, a hard drive is susceptible to just 10 volts. Integrated circuits (IC) are also prone to ESD and may be permanently damaged by high-voltage currents.

4) **Front-end-of-line** (**FEOL**) is the first portion of IC fabrication where the individual devices (transistors, capacitors, resistors, etc.) are patterned in the semiconductor. FEOL generally covers everything up to (but not including) the deposition of metal interconnect layers.

5) **Hard disk drive** (**HDD**) is a data storage device used for storing and retrieving digital information using rapidly rotating disks (platters) coated with magnetic material. An HDD retains its data even when powered off. Data is read in a random-access manner, meaning individual blocks of data can be stored or retrieved in any order rather than sequentially. An HDD consists of one or more rigid ("hard") rapidly rotating disks (platters) with magnetic headsarranged on a moving actuator arm to read and write data to the surfaces.

6) A **head-gimbal assembly** of a hard disk drive includes a loadbeam connected to a pivot arm, a slider on which a magnetic head is mounted, an elastic support member having one end coupled to the loadbeam and the other free end portion at which the slider is supported, and a damper provided between the loadbeam and the slider to attenuate vibration transferred between the loadbeam and the slider.

7) **IPC**, the **Association Connecting Electronics Industries**, is a trade association whose aim is to standardize the assembly and production requirements of electronic equipment and assemblies. IPC is accredited by the American National Standards Institute (ANSI) as a standards developing organization and is known globally for its standards. It publishes the most widely used acceptability standards in the electronics industry.

8) In manufacturing, **lot traceability** is readily-available access to the complete history of all manufactured **lots**, batches and serialized units, spanning production in multiple plants.

9) **MSDS** (an acronym for Material Safety Data Sheet) - is an important component of product stewardship and occupational safety and health. It is intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, point, flash, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. It is a written document that outlines information and procedures for handling and working with chemicals.

    Current MSDS documents contain physical and chemical property information, potential hazard information, emergency procedures, and manufacturer contact information. MSDS formats can vary from source to source within a country depending on national requirements.

10) **Out-of-control action plan (OCAP) -** is a flowchart that guides employees' reactions to out-of-control situations. It consists of activators (which define out-of-control conditions); checkpoints (which are likely causes for the conditions); and terminators (which contain the action that should resolve the conditions). OCAPs are dynamic. For example, Pareto analyses of OCAPs can identify commonly used terminators and suggests methods to eliminate frequent causes of problems or to modify the OCAPs that react to common out-of-control situations. Benefits of OCAPs include the empowerment given to the operators to troubleshoot problems. Other benefits are increased process efficiency and standardization of problem solving techniques.

11) **Personal Protective Equipment (PPE)** - specialized clothing or equipment worn by employees for protection against health and safety hazards. Personal protective equipment is designed to protect many parts of the body, i.e., eyes, head, face, hands, feet, and ears.

12) **Production line -** is a set of sequential operations established in a manufacturing establishment whereby materials are put through a process to produce an end-product. The machines and peripheral equipment are in the order they are used. The process is not stopped and restarted for each new product as the line is dedicated to producing a single or small group of products.

13) **Quality management system** (**QMS**) - is a collection of business processes focused on achieving your quality policy and quality objectives — i.e. what your customer wants and needs. It is expressed as the organizational structure, policies, procedures, processes and resources needed to implement quality management.

14) **Statistical process control** (**SPC**) - is a method of quality **control** which uses **statistical** methods. **SPC** is applied in order to monitor and **control** a **process**. Monitoring and controlling the **process** ensures that it operates at its full potential.

ANNEX A - COMPETENCY MAP
Electronics/Semiconductor Production Line Machine Servicing NC III

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 & 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 Devices	Configure & Test Mechatronics Devices	Maintain and Repair Mechatronics Devices
Develop Mechatronics Control Circuits & Software Application Programs	Commission Mechatronics Systems	Diagnose and Troubleshoot Mechatronics Systems	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
Setup Backend Operation Workplace for Electronics Production Line	Perform Backend Operation for Electronics Production Line	Setup Backend Operation Workplace for Semiconductor Production Line	Perform Backend Operation for Semiconductor Production Line	Check quality compliance of backend operation for Semiconductors production line
Check quality compliance of backend operation for electronics production line	Setup Front-of-Line (FOL) Operation Workplace for Electronics Production Line	Setup Front-of-Line (FOL) Operation Workplace for Semiconductor Production Line	Perform Front-of-Line (FOL) Operation for Semiconductor Production Line	Check quality compliance of Front-of-Line (FOL) operation for Semiconductors production line
Perform Front-of-Line (FOL) Operation for Electronics Production Line	Check quality compliance of Front-of-Line (FOL) operation for electronics production line	Setup Backend Operation Workplace for HDD Production Line	Perform Backend Operation for Hard Disk Drives (HDD) Production Line	Check quality compliance of backend operation for HDD production line
Perform Machine Setup/Conversion	**Perform Machine Troubleshooting and Repair**	Setup Front-of-Line (FOL) Operation Workplace for HDD Production Line	Perform Front-of-Line (FOL) Operation for HDD Production Line	Check quality compliance of Front-of-Line (FOL) operation for HDD production line
Monitor Machine Performance	**Perform Machine Preventive Maintenance and Calibration**			

Qualification Title : <u>Electronics/Semiconductor Production Line Machine</u>
<u>Servicing NC III</u>
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