TRAINING REGULATIONS

ELECTRONIC PRODUCTS ASSEMBLY AND SERVICING NC II

ELECTRONICS SECTOR

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Section 1   ELECTRONIC PRODUCTS ASSEMBLY AND SERVICING NC II QUALIFICATION

The **ELECTRONIC PRODUCTS ASSEMBLY AND SERVICING NC II** Qualification consists of competencies that a person must possess to assemble electronic products, prepare printed circuit boards (PCB) modules and to install and service consumer and industrial electronic products and systems.

This Qualification is packaged from the competency map of the Electronics Industry (Service sector) as shown in Annex A.

The units of competency comprising this qualification include the following:

Code	BASIC COMPETENCIES
5 00 311105	Participate in workplace communication
5 00 311106	Work in team environment
5 00 311107	Practice career professionalism
5 00 311108	Practice occupational health and safety procedures

Code	COMMON COMPETENCIES
ELC315202	Apply quality standards
ELC311203	Perform computer operations
ELC311201	Perform mensuration and calculation
ELC311202	Prepare and interpret technical drawing
ELC724201	Use hand tools
ELC724202	Terminate and connect electrical wiring and electronic circuits
ELC724205	Test electronic components

Code	CORE COMPETENCIES
ELC724335	Assemble Electronic Products
ELC724336	Service consumer electronic products and systems
ELC724337	Service industrial electronic modules, products and systems

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

- Electronic Products Assembler
- Domestic Appliance Service Technician
- Audio-Video Service Technician
- Industrial Electronic Technician
- Electronic Production Line Assembler
- Factory Production Worker

SECTION 2:   COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common, and core units of competency required for Electronic Products Assembly and Servicing NC II.

BASIC COMPETENCIES

UNIT OF COMPETENCY :   PARTICIPATE IN WORKPLACE COMMUNICATION
UNIT CODE   :   500311105
UNIT DESCRIPTOR   :   This unit covers the knowledge, skills and attitudes   required to gather, interpret and convey information in response to workplace requirements.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables
1. Obtain and convey workplace information	1.1 Specific and relevant information is accessed from *appropriate sources* 1.2 Effective questioning , active listening and speaking skills are used to gather and convey information 1.3 Appropriate *medium* is used to transfer information and ideas 1.4 Appropriate non- verbal communication is used 1.5 Appropriate lines of communication with supervisors and colleagues are identified and followed 1.6 Defined workplace procedures for the location and *storage* of information are used 1.7 Personal interaction is carried out clearly and concisely
2. Participate in workplace meetings and discussions	2.1 Team meetings are attended on time 2.2 Own opinions are clearly expressed and those of others are listened to without interruption 2.3 Meeting inputs are consistent with the meeting purpose and established *protocols* 2.4 *Workplace interactions* are conducted in a courteous manner 2.5 Questions about simple routine workplace procedures and matters concerning working conditions of employment are asked and responded to 2.6 Meetings outcomes are interpreted and implemented
3. Complete relevant work related documents	3.1 Range of *forms* relating to conditions of employment are completed accurately and legibly 3.2 Workplace data is recorded on standard workplace forms and documents 3.3 Basic mathematical processes are used for routine calculations 3.4 Errors in recording information on forms/ documents are identified and properly acted upon 3.5 Reporting requirements to supervisor are completed according to organizational guidelines

RANGE OF VARIABLES

VARIABLE	RANGE
1. Appropriate sources	1.1. Team members 1.2. Suppliers 1.3. Trade personnel 1.4. Local government 1.5. Industry bodies
2. Medium	2.1. Memorandum 2.2. Circular 2.3. Notice 2.4. Information discussion 2.5. Follow-up or verbal instructions 2.6. Face to face communication
3. Storage	3.1. Manual filing system 3.2. Computer-based filing system
4. Forms	4.1. Personnel forms, telephone message forms, safety reports
5. Workplace interactions	5.1. Face to face 5.2. Telephone 5.3. Electronic and two way radio 5.4. Written including electronic, memos, instruction and forms, non-verbal including gestures, signals, signs and diagrams
6. Protocols	6.1. Observing meeting 6.2. Compliance with meeting decisions 6.3. Obeying meeting instructions

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate:
	1.1. Prepared written communication following standard format of the organization
	1.2. Accessed information using communication equipment
	1.3. Made use of relevant terms as an aid to transfer information effectively
	1.4. Conveyed information effectively adopting the formal or informal communication
2. Underpinning Knowledge	2.1. Effective communication
	2.2. Different modes of communication
	2.3. Written communication
	2.4. Organizational policies
	2.5. Communication procedures and systems
	2.6. Technology relevant to the enterprise and the individual's work responsibilities
3. Underpinning Skills	3.1. Follow simple spoken language
	3.2. Perform routine workplace duties following simple written notices
	3.3. Participate in workplace meetings and discussions
	3.4. Complete work related documents
	3.5. Estimate, calculate and record routine workplace measures
	3.6. Basic mathematical processes of addition, subtraction, division and multiplication
	3.7. Ability to relate to people of social range in the workplace
	3.8. Gather and provide information in response to workplace Requirements
4. Resource Implications	4.1. Fax machine
	4.2. Telephone
	4.3. Writing materials
	4.4. Internet
5. Methods of Assessment	5.1. Direct Observation
	5.2. Oral interview
	5.3. Written test
6. Context for Assessment	6.1. Competency may be assessed individually in the actual workplace or through accredited institution

UNIT OF COMPETENCY: **WORK IN TEAM ENVIRONMENT**

UNIT CODE : **500311106**

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables
1. Describe team role and scope	1.1. The ***role and objective of the team*** is identified from available ***sources of information*** 1.2. Team parameters, reporting relationships and responsibilities are identified from team discussions and appropriate external sources
2. Identify own role and responsibility within team	2.1. Individual role and responsibilities within the team environment are identified 2.2. Roles and responsibility of other team members are identified and recognized 2.3. Reporting relationships within team and external to team are identified
3. Work as a team member	3.1. Effective and appropriate forms of communications used and interactions undertaken with team members who contribute to known team activities and objectives 3.2. Effective and appropriate contributions made to complement team activities and objectives, based on individual skills and competencies and ***workplace context*** 3.3. Observed protocols in reporting using standard operating procedures 3.4. Contribute to the development of team work plans based on an understanding of team's role and objectives and individual competencies of the members.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Role and objective of team	1.1. Work activities in a team environment with enterprise or specific sector 1.2. Limited discretion, initiative and judgement maybe demonstrated on the job, either individually or in a team environment
2. Sources of information	2.1. Standard operating and/or other workplace procedures 2.2. Job procedures 2.3. Machine/equipment manufacturer's specifications and instructions 2.4. Organizational or external personnel 2.5. Client/supplier instructions 2.6. Quality standards 2.7. OHS and environmental standards
3. Workplace context	3.1. Work procedures and practices 3.2. Conditions of work environments 3.3. Legislation and industrial agreements 3.4. Standard work practice including the storage, safe handling and disposal of chemicals 3.5. Safety, environmental, housekeeping and quality guidelines

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Operated in a team to complete workplace activity 1.2. Worked effectively with others 1.3. Conveyed information in written or oral form 1.4. Selected and used appropriate workplace language 1.5. Followed designated work plan for the job 1.6. Reported outcomes
2. Underpinning Knowledge and Attitude	2.1. Communication process 2.2. Team structure 2.3. Team roles 2.4. Group planning and decision making
3. Underpinning Skills	3.1. Communicate appropriately, consistent with the culture of the workplace
4. Resource Implications	The following resources **MUST** be provided: 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or tasks
5. Methods of Assessment	Competency may be assessed through: 5.1. Observation of the individual member in relation to the work activities of the group 5.2. Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
6. Context for Assessment	6.1. Competency may be assessed in workplace or in a simulated workplace setting 6.2. Assessment shall be observed while task are being undertaken whether individually or in group

UNIT OF COMPETENCY: **PRACTICE CAREER PROFESSIONALISM**

UNIT CODE **:** **500311107**

UNIT DESCRIPTOR **:** This unit covers the knowledge, skills and attitudes in promoting career growth and advancement.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables
1. Integrate personal objectives with organizational goals	1.1. Personal growth and work plans are pursued towards improving the qualifications set for the profession 1.2. Intra- and interpersonal relationships are maintained in the course of managing oneself based on performance *evaluation* 1.3. Commitment to the organization and its goal is demonstrated in the performance of duties
2. Set and meet work priorities	2.1. Competing demands are prioritized to achieve personal, team and organizational goals and objectives. 2.2. *Resources* are utilized efficiently and effectively to manage work priorities and commitments 2.3. Practices along economic use and maintenance of equipment and facilities are followed as per established procedures
3. Maintain professional growth and development	3.1. *Trainings and career opportunities* are identified and availed of based on job requirements 3.2 *Recognitions* are sought/received and demonstrated as proof of career advancement 3.3 *Licenses and/or certifications* relevant to job and career are obtained and renewed

RANGE OF VARIABLES

VARIABLE	RANGE
1. Evaluation	1.1 Performance Appraisal 1.2 Psychological Profile 1.3 Aptitude Tests

2. Resources	2.1 Human
	2.2 Financial
	2.3 Technology
	    2.3.1 Hardware
	    2.3.2 Software

3. Trainings and career opportunities	3.1 Participation in training programs
	    3.1.1 Technical
	    3.1.2 Supervisory
	    3.1.3 Managerial
	    3.1.4 Continuing Education
	3.2 Serving as Resource Persons in conferences and workshops

4. Recognitions	4.1 Recommendations 4.2 Citations 4.3 Certificate of Appreciations 4.4 Commendations 4.5 Awards 4.6 Tangible and Intangible Rewards
5. Licenses and/or certifications	5.1 National Certificates 5.2 Certificate of Competency 5.3 Support Level Licenses 5.4 Professional Licenses

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Attained job targets within key result areas (KRAs) 1.2 Maintained intra - and interpersonal relationship in the course of managing oneself based on performance evaluation 1.3 Completed trainings and career opportunities which are based on the requirements of the industries 1.4 Acquired and maintained licenses and/or certifications according to the requirement of the qualification
2. Underpinning Knowledge	2.1 Work values and ethics (Code of Conduct, Code of Ethics, etc.) 2.2 Company policies 2.3 Company-operations, procedures and standards 2.4 Fundamental rights at work including gender sensitivity 2.5 Personal hygiene practices
3. Underpinning Skills	3.1 Appropriate practice of personal hygiene 3.2 Intra and Interpersonal skills 3.3 Communication skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Workplace or assessment location 4.2 Case studies/scenarios
5. Methods of Assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Simulation/Role-plays 5.4 Observation 5.5 Third Party Reports 5.6 Exams and Tests
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY :   **PRACTICE OCCUPATIONAL HEALTH AND SAFETY PROCEDURES**

UNIT CODE   :   **500311108**

UNIT DESCRIPTOR   :   This unit covers the knowledge, skills and attitudes required to comply with regulatory and organizational requirements for occupational health and safety.

ELEMENT	PERFORMANCE CRITERIA *Italicized* terms are elaborated in the Range of Variables
1. Identify hazards and risks	1.1 *Safety regulations* and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures 1.2 *Hazards/risks* in the workplace and their corresponding indicators are identified to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures 1.3 *Contingency measures* during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures
2. Evaluate hazards and risks	2.1 Terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV) 2.2 Effects of the hazards are determined 2.3 OHS issues and/or concerns and identified safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation
3. Control hazards and risks	3.1 Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed 3.2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OHS policies 3.3 *Personal protective equipment (PPE)* is correctly used in accordance with organization OHS procedures and practices 3.4 Appropriate assistance is provided in the event of a workplace emergency in accordance with established organization protocol
4. Maintain OHS awareness	4.1 *Emergency-related drills and trainings* are participated in as per established organization guidelines and procedures 4.2 *OHS personal records* are completed and updated in accordance with workplace requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Safety regulations	May include but are not limited to: 1.1 Clean Air Act 1.2 Building code 1.3 National Electrical and Fire Safety Codes 1.4 Waste management statutes and rules 1.5 Philippine Occupational Safety and Health Standards 1.6 DOLE regulations on safety legal requirements 1.7 ECC regulations

2. Hazards/Risks	May include but are not limited to:
	2.1 Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation
	2.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects
	2.3 Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors
	2.4 Ergonomics
	    2.4.1 Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles
	    2.4.2 Physiological factors – monotony, personal relationship, work out cycle

3. Contingency measures	May include but are not limited to: 3.1 Evacuation 3.2 Isolation 3.3 Decontamination 3.4 (Calling designed) emergency personnel
4. Personal Protective Equipment	May include but are not limited to: 4.1 Mask 4.2 Gloves 4.3 Goggles 4.4 Hair Net/cap/bonnet 4.5 Face mask/shield 4.6 Ear muffs 4.7 Apron/Gown/coverall/jump suit 4.8 Anti-static suits

VARIABLE	RANGE
5. Emergency-related drills and training	5.1 Fire drill 5.2 Earthquake drill 5.3 Basic life support/CPR 5.4 First aid 5.5 Spillage control 5.6 Decontamination of chemical and toxic 5.7 Disaster preparedness/management
6. OHS personal records	6.1 Medical/Health records 6.2 Incident reports 6.3 Accident reports 6.4 OHS-related training completed

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Explained clearly established workplace safety and hazard control practices and procedures 1.2 Identified hazards/risks in the workplace and its corresponding indicators in accordance with company procedures 1.3 Recognized contingency measures during workplace accidents, fire and other emergencies 1.4 Identified terms of maximum tolerable limits based on threshold limit value- TLV. 1.5 Followed Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace 1.6 Used Personal Protective Equipment (PPE) in accordance with company OHS procedures and practices 1.7 Completed and updated OHS personal records in accordance with workplace requirements
2. Underpinning Knowledge	2.1 OHS procedures and practices and regulations 2.2 PPE types and uses 2.3 Personal hygiene practices 2.4 Hazards/risks identification and control 2.5 Threshold Limit Value -TLV 2.6 OHS indicators 2.7 Organization safety and health protocol 2.8 Safety consciousness 2.9 Health consciousness
3. Underpinning Skills	3.1 Practice of personal hygiene 3.2 Hazards/risks identification and control skills 3.3 Interpersonal skills 3.4 Communication skills
4. Resource Implications	The following resources must be provided: 4.1 Workplace or assessment location 4.2 OHS personal records 4.3 PPE 4.4 Health records
5. Methods of Assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Case Study/Situation
6. Context for Assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

COMMON COMPETENCIES

UNIT TITLE   :   **APPLY QUALITY STANDARDS**
UNIT CODE   :   **ELC315202**
UNIT DESCRIPTOR   :   This unit covers the knowledge, skills and attitudes 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
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
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
3. Engage in quality improvement	3.1. Process improvement procedures are participated in relation to workplace assignment 3.2. Work is carried out in accordance with process improvement procedures 3.3. Performance of operation or quality of product or service to ensure *customer* satisfaction is monitored

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. Underpinning knowledge	2.1. Relevant production processes, materials and products
	2.2. Characteristics of materials/component parts used in electronic production processes
	2.3. Quality checking procedures
	2.4. Workplace procedures
	2.5. Safety and environmental aspects of production processes
	2.6. Fault identification and reporting
	2.7. Quality improvement process
3. Underpinning skills	3.1. Reading skills required to interpret work instruction
	3.2. Communication skills needed to interpret and apply defined work procedures
	3.3. Carry out work in accordance with OHS policies and procedures
4. Method of assessment	4.1. The assessor may select at least two (2) of the following assessment methods to objectively assess the candidate: 4.1.1. Observation 4.1.2. Questioning 4.1.3. Practical demonstration
5. Resource implication	5.1. Materials and component parts and equipment to be used in a real or simulated electronic production situation
6. Context of Assessment	6.1. 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
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
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*
3. Access information using computer	3.1. Correct program/application is selected based on job requirements 3.2. Program/application containing the information required is accessed according to company procedures 3.3. *Desktop icons* are correctly selected, opened and closed for navigation purposes 3.4. Keyboard techniques are carried out in line with OH & S requirements for safe use of keyboards
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
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

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 include 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. Selected and used hardware components correctly and according to the task requirement 1.2. Identified and explained the functions of both hardware and software used, their general features and capabilities 1.3. Produced accurate and complete data in accordance with the requirements 1.4. Used appropriate devices and procedures to transfer files/data accurately 1.5. Maintained computer system
2. Underpinning knowledge	2.1. Basic ergonomics of keyboard and computer use 2.2. Main types of computers and basic features of different operating systems 2.3. Main parts of a computer 2.4. Storage devices and basic categories of memory 2.5. Relevant types of software 2.6. General security 2.7. Viruses 2.8. OH & S principles and responsibilities 2.9. Calculating computer capacity
3. Underpinning skills	3.1. Reading skills required to interpret work instruction 3.2. Communication skills
4. Method of assessment	4.1. The assessor may select at least two of the following assessment methods to objectively assess the candidate: 4.1.1. Observation 4.1.2. Questioning 4.1.3. Practical demonstration
5. Resource implication	5.1. Computer hardware with peripherals 5.2. Appropriate software
6. Context of Assessment	6.1. Assessment may be conducted in the workplace or in a simulated work environment

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

ELEMENT	PERFORMANCE CRITERIA *Italicized Bold* terms are elaborated in the Range of Variables
1. Select measuring instruments	1.1. Object or component to be measured is identified according to procedures 1.2. Correct specifications are obtained from relevant source 1.3. Measuring tools are selected in line with job requirements
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 checked and corrected for accuracy 2.6. Instruments are read to the limit of accuracy of the tool.
3. Maintain measuring instruments	3.1. Measuring instruments are handles without damage according to procedures 3.2. Measuring instruments are cleaned before and after using. 3.3. Proper storage of instruments are undertaken according to manufacturer's specifications and standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Measuring instruments	1.1. Vernier caliper 1.2. English/Metric rule 1.3. Torque gauge 1.4. Tri-square 1.5. Protractor 1.6. Level spirit 1.7. Combination gauge
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. Underpinning knowledge	2.1. Types of measuring instruments and their uses 2.2. Safe handling procedures in using measuring instruments 2.3. Four fundamental operation of mathematics 2.4. Formula for volume, area, perimeter and other geometric figures
3. Underpinning skills	3.1. Reading skills required to interpret work instruction 3.2. Communication skills 3.3. Handling measuring instruments 3.4. Performing mathematical calculations using the four fundamental operations 3.5. Visualizing objects and shapes 3.6. Interpreting formulae
4. Method of assessment	Competency in this unit must be assessed through: 4.1. Observation 4.2. Oral questioning

5. Resource implication	5.1. Place of assessment
	5.2. Measuring instruments
	    5.2.1. Vernier caliper
	    5.2.2. English/Metric rule
	    5.2.3. Torque gauge
	    5.2.4. Tri-square
	    5.2.5. Protractor
	    5.2.6. Level spirit
	    5.2.7. Combination gauge

6. Context of Assessment	6.1. Assessment may be conducted in the workplace or in a simulated work 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
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
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.
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.
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.

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 require 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. Underpinning knowledge	2.1. Drawing conventions
	2.2. Symbols
	2.3. Dimensioning Conventions
	2.4. Mark up/Notation of Drawings
	2.5. Mathematics
	    2.5.1. Four fundamental operations
	    2.5.2. Percentage
	    2.5.3. Fraction
	    2.5.4. Trigonometric Functions
	    2.5.5. Algebra
	    2.5.6. Geometry

3. Underpinning skills	3.1. Reading skills required to interpret work instruction 3.2. Communication skills 3.3. Interpreting electrical/electronic signs and symbols
4. Method of assessment	Competency in this unit must be assessed through: 4.1. Practical tasks involving interpretation of a range of technical drawings 4.2. Oral questioning
5. Resource implication	5.1. Drawings 5.2. Diagrams 5.3. Charts 5.4. Plans
6. Context of Assessment	Assessment may be conducted in the workplace or in a simulated environment

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
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
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
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
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

RANGE OF VARIABLES

VARIABLE	RANGE

1. Hand tools	1.1. Hand tools for adjusting, dismantling, assembling, finishing and cutting. Tool set includes the following but not limited to:
	   1.1.1. set of screw drivers
	   1.1.2. set of pliers
	   1.1.3. set of wrenches
	   1.1.4. set of files
	   1.1.5. hand drills
	   1.1.6. hack saw
	   1.1.7. tin snip

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. Underpinning knowledge	2.1. Safety
	    2.1.1. Safety requirements in handling tools
	2.2. Tools
	    2.2.1. Function, Operation, Common faults
	2.3. Processes, Operations, Systems
	    2.3.1. Maintenance of tools
	    2.3.2. Storage of Tools

3. Underpinning skills	3.1. Reading skills required to interpret work instruction and numerical skills 3.2. Communication skills 3.3. Problem solving in emergency situation
4. Method of assessment	Competency in this unit must be assessed through: 4.1. Observation 4.2. Oral questioning

5. Resource Implication	5.1. Tools may include the following but not limited to:
	    5.1.1. set of screw drivers
	    5.1.2. set of pliers
	    5.1.3. set of wrenches
	    5.1.4. set of files
	    5.1.5. hand drills
	    5.1.6. hack saw
	    5.1.7. tin snip

6. Context of Assessment	6.1. Assessment may be conducted in the workplace or in a simulated work environment

	UNIT TITLE	:	**TERMINATE AND CONNECT ELECTRICAL WIRING AND ELECTRONICS CIRCUIT**
	UNIT CODE	:	ELC724202
	UNIT DESCRIPTOR	:	This unit covers the knowledge, skills and attitudes needed to terminate and connect electrical wiring and electronic circuits

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

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. Underpinning knowledge	2.1. Use of tools
	2.2. Use of test instruments/equipment
	2.3. Electrical theory
	2.4. Single phase AC principles
	2.5. Wiring techniques
	2.6. DC power supplies
	2.7. Soldering
3. Underpinning skills	3.1. Reading skills required to interpret work instruction
	3.2. Communication skills
	3.3. Soldering techniques
4. Method of assessment	4.1. The assessor may select at least two (2) of the following assessment methods to objectively assess the candidate:
	4.1.1. Observation
	4.1.2. Oral Questioning
	4.1.3. Practical demonstration
5. Resource implication	5.1. Tools for measuring, cutting, drilling, assembling/disassembling, connecting. Tool set includes the following but not limited to:
	5.1.1. Screw drivers
	5.1.2. Pliers
	5.1.3. Cutters
6. Context of Assessment	6.1. Assessment may be conducted in the workplace or in a simulated work environment

UNIT OF COMPETENCY: **TEST ELECTRONIC COMPONENTS**
UNIT CODE   : **ELC724xxx**
DESCRIPTON   : This unit covers the knowledge, skills and attitudes required to test electronic components. It includes competencies in determining the criteria for testing electronics components, planning an approach for component testing, testing the components and evaluating the testing process.

ELEMENTS	PERFORMANCE CRITERIA *(Italicized bold terms are elaborated in the range of variables)*
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
2. Plan an approach for component testing	2.1 Various ***testing methods*** are Identified based on ***types of electronic components*** 2.2 Characteristics and appropriateness of testing methods to be used during development and on completion is 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
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
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.

RANGE OF VARIABLES

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

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

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate:
	1.1 Determined criteria for testing electronics components
	1.2 Planned an approach for component testing
	1.3 Tested components
	1.4 Evaluated the testing process
2 Required knowledge and attitude	2.1 Mensuration/Mathematics
	2.1.1 Conversion of Units
	2.1.2 Applied Mathematics
	2.2 Safety
	2.2.1 Work Safety requirements and economy of materials with durability
	2.2.2 Knowledge in 5S application and observation of required timeframe
	2.2.3 Knowledge of proper handling and disposal of chemicals
	2.3 Materials, tools and equipment uses and specifications
	2.3.1 Identification of hand and power tools
	2.3.2 Proper care and use of tools
	2.4 Systems and Processes
	2.4.1 Principles of electrical/electronic circuits
	2.4.2 Identifying sources of electricity
	2.4.3 Identifying conductors and insulators
	2.4.4 Describing resistance and identify resistors
	2.4.5 Supplying different voltage using variable power supply
	2.4.6 Measuring resistance using VOM
	2.4.7 Testing resistors
	2.4.8 Measuring current and voltage using VOM
	2.4.9 Analyzing simple circuit using ohms and power law
	2.4.10 Analyzing series/parallel circuits using ohms and power law
	2.4.11 Describing alternating current circuits
	2.4.12 Observing waveform using oscilloscope
	2.4.13 generating waveform in various frequency using function generator
	2.4.14 Measuring frequency using oscilloscope
	2.4.15 Measuring capacitance using VOM
	2.4.16 Describing capacitance and identifying capacitors
	2.4.17 Testing capacitors
	2.4.18 Analyzing series/parallel capacitances
	2.4.19 Describing inductance and identifying inductors
	2.4.20 Testing inductors
	2.4.21 analyzing series parallel inductors
	2.4.22 describing the characteristic of transformers
	2.4.23 describing and identifying semiconductor diode

		2.4.24 testing semiconductor diode 2.4.25 analyzing rectifier circuits 2.4.26 describing and identifying bipolar transistor 2.4.27 testing bipolar transistor 2.4.28 analyzing amplifier circuit 2.4.29 analyzing multi-vibrator circuit 2.4.30 describing and analyzing digital gate 2.4.31 testing logic gates 2.4.32 analyzing logic networks 2.4.33 analyzing sequence circuits
3	Required skills	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
4	Method of assessment	Competency may be assessed through two or more of the following methods: 4.1 Direct observation of application to tasks and questions related to required knowledge 4.2 Demonstration with oral questioning 4.3 Third party report 4.4 Written test 4.5 Portfolio
5	Resource implications	The following resources must be provided: 5.1 Tools and equipment (see range of variables) 5.2 Working area/bench 5.3 Electronic components 5.4 Testing instruments and equipment 5.5 Assessment rating sheet 5.6 Reporting forms
6	Context of assessment	6.1 Assessment maybe conducted in the workplace or in a simulated workplace setting

CORE COMPETENCIES

UNIT OF COMPETENCY: **ASSEMBLE ELECTRONIC PRODUCTS**
UNIT CODE   : **ELC724335**
DESCRIPTON   : This unit covers the knowledge, skills and attitudes required to assemble electronic products and systems for consumer/ industrial uses/applications. It consist of competencies in identifying and preparing electronic components and circuits, preparing/making printed circuit board (PCB) modules, mounting and soldering of components, assembling electronic products and performing mechanical and electrical/electronic tests.

ELEMENTS	PERFORMANCE CRITERIA *(Italicized bold terms are elaborated in the range of variables)*
1. Prepare to assemble electronic products	1.1 Assembly workplace is prepared in accordance with ***OH&S policies and procedures*** 1.2 Established risk control measures for work preparation are followed. 1.3 Work instructions are obtained and clarified based on job order or client requirements 1.4 ***Responsible person*** is consulted for effective and proper work coordination 1.5 Required ***materials, tools and equipment*** are prepared and checked in accordance with established procedures 1.6 Parts and components needed to complete the work are identified, prepared and obtained according to requirements
2. Prepare/ Make PCB modules	2.1 PCB layout is verified for conformity with the schematic diagram in accordance with the ***layout rules*** 2.2 PCB layout is transferred to copper-cladded board following ***acceptable methods*** and standards 2.3 Visual inspection is performed based on standards procedures. 2.4 Thru-hole is drilled based on standards procedures 2.5 PCB is cleaned based on standards procedures 2.6 Functionality of PCB is tested and visual inspection is performed based on standards procedures
3. Mount and solder electronic components	3.1 Knowledge of lead and lead-free soldering characteristics and requirements are applied to mounting and soldering process in accordance with OH&S standards 3.2 Components are ***mounted*** and soldered in accordance with ***soldering principles.*** 3.3 Soldering/Desoldering techniques and ***procedures*** are applied in accordance with established standards and requirements. 3.4 Soldered products are checked and complied with international standards and task specifications
4. Perform electronic products assembly	4.1 Work instructions is followed based on job order or client requirements 4.2 ***Assembly procedur***es are performed in accordance with OH&S policies and work instructions 4.3 Modules and accessories are connected/integrated into the final product based on the client specifications

ELEMENTS	PERFORMANCE CRITERIA *(Italicized bold terms are elaborated in the range of variables)*
	4.4 Excess components and materials are disposed of based on WEEE directives and 3Rs waste management program.
5. Test and inspect assembled electronic products	5.1 Finished products are subjected to final visual/sensory inspection and ***testing*** in accordance with quality standards, procedures and requirements 5.2 Mechanical and electrical/electronic testing is performed in accordance with quality standards, procedures and requirements 5.3 Work completion is documented and responsible person is informed in accordance with established procedures 5.4 Housekeeping procedures are observed in accordance with 5S discipline and established procedures

RANGE OF VARIABLES

VARIABLE	RANGE

1. OH&S policies and procedures	Arrangements of enterprise to meet their legal and ethical obligations in ensuring the workplace is safe and without risk to health. This may include:
	1.1 Hazard and risk assessment mechanisms
	1.2 Implementation of safety regulations
	1.3 Safety training
	1.4 Safety systems incorporating:
	      1.4.1 Work clearance procedures
	      1.4.2 Isolation procedures
	      1.4.3 Gas and vapor
	      1.4.4 Monitoring/testing procedures
	      1.4.5 Use of protective equipment and clothing
	1.5 Use of codes of practice
	      1.5.1 Philippine Electronics Code

2. Responsible person	2.1 Immediate supervisor 2.2 Manager
3. Materials, tools and equipment	May include: 3.1 Variable power supply 3.14 ESD-free work bench with 3.2 Variable transformer mirror 3.3 Soldering iron 3.15 Oscilloscope, digital 3.4 Hot air soldering station 3.16 High-grade magnifying glass 3.5 Table top reflow oven with lamp 3.6 Desoldering tools 3.17 Flashlight/headlamp 3.7 Screwdriver (assorted) 3.18 Cleaning brush 3.8 Wrenches (assorted) 3.19 Soldering wire 3.9 Allen wrench/key 3.20 SMD soldering paste 3.10 Function/Signal generator 3.21 Stranded/solid/hook-up wires 3.11 Multi-testers (analog/digital) 3.22 Assorted electronic components 3.12 Utility knife/stripper 3.23 Assorted electronic sensors 3.13 Pliers (assorted)
4. Layout rules	4.1 EMI 4.2 EMC
5. Acceptable methods	5.1 silk screen 5.2 photo transfer
6. Mounting of components	6.1 Surface mount 6.2 Thru-hole mount 6.3 Socket mount
7. Soldering principles	The four key principles to producing a good joint are: 7.1 Ensure the joint surfaces are clean and free from grease. 7.2 Ensure the temperature of the solder when making the joint is correct. 7.3 Ensure the heat is applied to the joint for the correct amount of time 7.4 Ensure the correct amount of solder is used.
8. Soldering/ Desoldering procedures	8.1 Hot iron soldering procedures 8.2 Hot air soldering procedures
9. Assembly procedures	9.1 Prepare supplies, materials and equipment 9.2 Familiarize with the diagram and the product 9.3 Perform assembly 9.4 Check the assembled product
10. Testing	10.1 Aging test 10.2 Substitution test 10.3 Mechanical testing

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate:
	1.1 Prepared electronics components for assembly
	1.2 Prepared/Made printed circuit board modules
	1.3 Mounted and soldered electronic components
	1.4 Assembled electronic components
	1.5 Tested and inspected assembled electronic products
	1.6 Applied safety rules and procedures
2 Required knowledge and attitude	2.1 Mensuration/Mathematics
	2.1.1 Conversion of Units
	2.1.2 Applied Mathematics
	2.2 Environmental Safety
	2.2.1 Work Safety requirements and economy of materials with durability
	2.2.2 Knowledge in 5S application and observation of required timeframe
	2.2.3 Knowledge of proper handling and disposal of chemicals
	2.2.4 Safety handling of hand tools
	2.2.5 Practicing 3Rs – reduce, re-use, recycle/recover
	2.2.6 Managing waste from electrical and electronic equipment (WEEE)
	2.3 Materials, tools and equipment uses and specifications
	2.3.1 Identification of hand and power tools
	2.3.2 Proper care and use of tools
	2.4 Theories and Principles
	2.4.1 PCB problems and solutions
	2.4.2 Surface mount components and devices
	2.4.3 Through-hole mount components and devices
	2.4.4 PCB characteristics
	2.4.5 Methods of soldering
	2.4.6 Design compliance with EMI / EMC
	2.4.7 Component layout and grounding
	2.4.8 Thermal and vibration theories
	2.4.9 Environmental control
	2.4.10 Manufacturing
	- PCB Manufacturing Information
	- PCB Layout and Artwork
	2.4.11 Fabrication
	- Blanking, Cutting, Punching, Drilling
	- Laminating Techniques
	- Plating, Etching, Surface Finishing
	- Coatings
	2.4.12 Assembly
	- Proper care and use of tools
	- Component
	- Soldering Technology
	i. Reflow soldering
	ii. Wave soldering
	iii. Hand soldering
	iv. RoHS and lead-free soldering
	- Nonsolder Connections (terminal block

		- Cleaning
		- Repair and Rework
		- Safety
		- ESD protection
		    2.4.13 Testing of electronic products
		2.5 3Rs waste management programs
		2.6 Rules and conventions
		    2.6.1 Philippine Electronics Code
		    2.6.2 RoHS/WEEE Directives
		    2.6.3 RA 9292 – ECE Law

3	Required skills	3.1 assembling electronic products 3.2 Using and maintaining test instruments, tools, & equipment 3.3 splicing/joining wires 3.4 PCB preparation skills 3.5 Proper soldering/desoldering skills 3.6 Component testing 3.7 mounting various types of electronic components 3.8 Work safety practices and time management 3.9 interpreting schematic/block diagrams
4	Method of assessment	Competency may be assessed through two or more of the following methods: 4.1 Practical Demonstration w/ oral questioning 4.2 Interview 4.3 Portfolio
5	Resource implications	The following resources must be provided: 5.1 Tools and equipment (see range of variables) 5.2 Working area/bench 5.3 PC with computer-aided design (CAD) software and printer PCBs 5.4 electronic components/supplies 5.5 diagrams and other references 5.6 Assessment rating sheet 5.7 Reporting forms
6	Context of assessment	6.1 Assessment maybe conducted in the workplace or in a simulated workplace setting

UNIT OF COMPETENCY: **SERVICE CONSUMER ELECTRONIC PRODUCTS AND SYSTEMS**

UNIT CODE : **ELC724336**

DESCRIPTON : This unit covers the knowledge, skills and attitudes required to install and service consumer electronic products and systems. It includes competencies in installing, maintenance and repairing audio-video products/ systems and domestic electronic appliances and home security system.

ELEMENT	PERFORMANCE CRITERIA (*Italicized bold* terms are elaborated in the range of variables)
1. Prepare unit, tools and workplace for installation and service	1.1 Complete check-up of *consumer electronic products and systems* is conducted and defects are identified, verified and documented against customer description. 1.2 *Manuals* and *service information* required for installation are acquired as per standard procedure. 1.3 Repair/maintenance history is verified in line with the company procedures. 1.4 Workplace is set/prepared for installation job in line with the client's requirements. 1.5 Necessary *tools*, *test instruments and personal protective equipment* are prepared in line with job requirements
2. Install consumer electronic products and systems	2.1 Materials necessary to complete the work are obtained in accordance with job requirements. 2.2 Consumer electronic products and systems are installed in accordance with manufacturer's instructions, requirements, and without damage to the surrounding place or environment 2.3 Devices are tested in accordance with standard procedures. 2.4 Final inspections are undertaken to ensure that the installed devices conforms to technical requirements. 2.5 Unplanned events or conditions are responded to in accordance with established procedures 2.6 Work site is cleaned and cleared of all debris and left safe in accordance with the company requirements 2.7 Report on installation and testing of equipment is prepared according to company's procedures/policies.
3. Diagnose faults and defects of consumer electronic products and systems	3.1 Systematic *pre-testing procedure* is observed in accordance with manufacturer's instructions. 3.2 System defects/Fault symptoms are identified using appropriate tools and equipment and *troubleshooting techniques* and in accordance with safety procedures 3.3 Test instruments required for the job are used in accordance with user manuals. 3.4 Circuits are checked and isolated using specified testing procedures 3.5 Identified defects and faults are explained to the *responsible person* in accordance with enterprise or company policy and procedures 3.6 Control settings/adjustments are checked in conformity with service-manual specifications. 3.7 Results of diagnosis and testing are documented accurately and completely within the specified time. 3.8 Customers are advised/informed regarding the status and serviceability of the unit according to procedures.

ELEMENT	PERFORMANCE CRITERIA (*Italicized bold* terms are elaborated in the range of variables)
4. Maintain/Repair consumer electronic products	4.1 Personal protective equipment is used in accordance with Occupational Health and Safety practices. 4.2 Electro-static discharge (ESD) protection procedure is followed in accordance with current industry standards. 4.3 Defective parts/components are replaced with identical or recommended appropriate equivalent ratings 4.4 Repaired or replaced parts/components are soldered/mounted in accordance with the current industry standards. 4.5 Control settings/adjustments are performed in conformity with service-manual specifications 4.6 Repair activity is performed within the required timeframe 4.7 Care and extreme precaution in handling the unit/product is observed as per procedures 4.8 Cleaning of unit is performed in accordance with standard procedures 4.9 Excess components and materials are disposed of based on WEEE directives and 3Rs waste management program
5. Re-assemble and test repaired consumer electronic product	5.1 Repaired units are reassembled according to procedures 5.2 Reassembled units are subjected to final testing and cleaning in conformity with manufacturer's specifications 5.3 Service completion procedures and documentations are complied with based on manual. 5.4 Waste materials are disposed of in accordance with *environmental requirements.*

RANGE OF VARIABLES

VARIABLE	RANGE

1. Consumer electronic products and systems	1. Audio-Video products and systems include --
	  1.1 Radio receivers
	  1.2 Audio recorders
	  1.3 Videoke systems
	  1.4 Electronic musical instruments/keyboards
	  1.5 DVD/VCD Player
	  1.6 Professional audio/Public-address (PA) systems
	  1.7 Television
	      1.7.1 Home
	      1.7.2 Portable
	  1.8 Home theater system
	  1.9 PC Monitors
	
	2. Domestic Electronic Appliances include --
	  2.1 Electronic-controlled Washing Machines
	  2.2 Home Food Processing equipment
	  2.3 Microwave Oven
	  2.4 Electronic Clock
	  2.5 Rechargeable Light
	  2.6 Electronic-controlled Light
	  2.7 Home security equipment
	  2.8 Induction stove
	  2.9 Solar-powered management system

2. Service manuals	2.1. Service manual/schematic diagram/parts list 2.2. Operating instructions/User's/Owner's manual
3. Service Information	3.1. Job Report Sheets 3.2. Job Order 3.3. Bill of materials 3.4. Customer index 3.5. Service flowchart 3.6. Stock and inventory record 3.7. Requisition slips (for acquisition of parts) 3.8. Supplier Index
4. Tools, Materials and Test Instruments	May include: 4.1 Variable power supply 4.2 Variable transformer 4.3 Soldering iron 4.4 Hot air soldering station 4.5 Table top reflow oven 4.6 Desoldering tools 4.7 Screwdriver (assorted) 4.8 Wrenches (assorted) 4.9 Allen wrench/key 4.10 Function generator 4.11 Multi-testers (analog/digital) 4.12 Utility knife/stripper 4.13 Pliers (assorted) 4.14 ESD-free work bench with mirror 4.15 Test jigs 4.16 Oscilloscope, digital 4.17 High-grade magnifying glass with lamp 4.18 Flashlight/headlamp 4.19 Cleaning brush 4.20 Soldering wire 4.21 SMD soldering paste 4.22 Stranded/solid/hook-up wires 4.23 Assorted electronic components

VARIABLE	RANGE
5. Pre-testing procedures	5.1. Visual inspection of the unit with power off 5.2. Interview of customer re history of unit 5.3. Operate the unit according to manual to confirm defects

6. Troubleshooting techniques	May include:
	6.1 sensory methods
	      Visual checks
	      Listening for telltale sounds
	      Lookout for unusual smells
	      Touching or feeling
	6.2 Component substitution
	6.3 Signal injection and tracing
	6.4 Voltage and current measurement
	6.5 Continuity/resistance testing
	6.6 Waveform analysis
	6.7 Display analysis (for video displays)
	6.8 Circuit analysis

7. Responsible persons	7.1. Immediate supervisor 7.2. Service supervisor/manager
8. Environmental Requirements	8.1. Proper disposal of chemicals and components shall be based on existing requirements of the law and chemical waste management 8.2. Non-biodegradable parts or materials shall be packed and labeled properly for disposal. 8.3. WEEE requirements

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Prepared the unit and required materials, tools equipment and workplace properly for installation and service. 1.2 Installed consumer electronic products and systems 1.3 Diagnosed faults and defects 1.4 Maintained/Repaired consumer electronic products 1.5 Re-assembled and tested repaired consumer electronic product 1.6 Applied safety rules and procedures

2 Required knowledge and attitude	2.1 Mensuration/Mathematics
	    2.1.1 Conversion of units
	    2.1.2 Applied mathematics
	2.2 Drawing and Schematic Diagram
	    2.2.1 Reading and interpreting orthographic projections and isometric views
	    2.2.2 Reading and interpreting electronic schematic symbols and diagram
	2.3 Environmental Safety
	    2.3.1 Work Safety requirements and economy of materials with durability
	    2.3.2 Knowledge in 5S application and observation of required procedure
	    2.3.3 Practicing 3Rs – reduce, re-use, recycle/recover
	    2.3.4 Managing waste from electrical and electronic equipment (WEEE)
	2.4 Materials, tools/instruments & equipment uses and specifications
	    2.4.1 Identification of hand and power tools
	    2.4.2 Proper care and use of tools
	    2.4.3 Identification of test and measuring instruments
	    2.4.4 Proper care and use of test and measuring instruments
	2.5 System and Processes
	    2.5.1 Principles of electrical circuits
	    2.5.2 Fundamentals of direct current circuits
	    2.5.3 Fundamentals of alternating current circuits
	    2.5.4 Fundamentals of electronic components and circuits
	    2.5.5 Fundamentals of digital logics, components & circuits
	    2.5.6 Fundamentals of microprocessor circuits and programming
	    2.5.7 Analysis of troubles and isolation techniques
	    2.5.8 Principles of sound and acoustics
	    2.5.9 Fundamentals of audio amplifiers
	    2.5.10 Fundamentals of audio source & noise reduction system
	    2.5.11 Fundamentals of AM & FM Receivers
	    2.5.12 Principles of vision and color
	    2.5.13 Fundamentals of color television
	    2.5.14 Fundamentals of video sources & noise reduction system
	2.6 Theories and Principles
	    2.6.1 AM transmission and reception
	    2.6.2 FM transmission and reception
	    2.6.3 Analog TV transmission and reception

		2.6.4 Digital HDTV transmission and reception
		2.6.5 Audio Video sources and formats
		2.6.6 Pulse Code Modulation
		2.6.7 Home theater system
		2.6.8 Digital noise reduction system
		2.6.9 CCTV system
		2.6.10 Infrared remote control system
		2.6.11 Motor and motor control system
		2.6.12 LED and lighting system
		2.6.13 Heat and heating control system
		2.6.14 Solar cell and battery management system
		2.6.15 Microcontroller
		2.6.16 Microcontroller interfacing
		2.7 Consumer electronic products and systems installation procedures
		2.8 Systematic pre-testing procedures
		2.9 System defects/Fault symptoms
		2.10 Mechanical and electrical/electronic testing
		2.11 Commissioning procedures
		2.12 3Rs waste management programs
		2.13 Rules and conventions
		
		     2.13.1 Philippine Electronics Code
		
		     2.13.2 RoHS/WEEE Directives
		
		     2.13.3 RA 9292 – ECE Law commissioning procedures

3	Required skills	3.1 Application of troubleshooting technique 3.2 Using and maintaining test instruments, tools, & equipment 3.3 Application of work safety practices and time management 3.4 Application of substitution technique 3.5 Soldering/desoldering and wiring/cabling techniques 3.6 Schematic diagram reading skills
4	Method of assessment	Competency may be assessed through: 4.1 Practical Demonstration w/ oral questioning 4.2 Interview 4.3 Portfolio
5	Resource implications	The following resources must be provided: 5.1 Tools, equipment and test instruments 5.2 Needed audio-video products and systems 5.3 Needed consumer appliances 5.4 Service manuals/schematics 5.5 ESD free working area/bench 5.6 Needed electronic spare parts/supplies
6	Context of assessment	6.1 Assessment maybe conducted in the workplace or in a simulated workplace setting

UNIT OF COMPETENCY: **SERVICE INDUSTRIAL ELECTRONIC MODULES, PRODUCTS AND SYSTEMS**

UNIT CODE   : **ELC724337**

DESCRIPTON   : This unit covers the knowledge, skills and attitudes required to install and service industrial electronic modules, products and systems. It consists of competencies in installing, troubleshooting, maintenance and repairing industrial electronic modules, products and systems.

ELEMENT	PERFORMANCE CRITERIA *(Italicized bold* **terms are elaborated in the range of variables)**
1. Prepare unit, tools and workplace for installation / servicing	1.1 Complete check-up of ***industrial electronic components, products and systems*** is conducted and defects are identified, verified and documented against customer description. 1.2 Repair/maintenance history is verified in line with the company procedures. 1.3 ***Service manuals*** and ***service information*** required for repair/maintenance are acquired as per standard procedure. 1.4 Workplace is set/prepared for repair job in line with the company requirements. 1.5 Necessary ***tools***, ***test instruments and personal protective equipment*** are prepared in line with job requirements
2. Install industrial electronic modules/ products/ systems	2.1 Materials necessary to complete the work are obtained in accordance with job requirements. 2.2 Industrial electronic modules/ products/systems are installed in accordance with manufacturer's instructions, requirements, and without damage to the surrounding place or environment 2.3 Devices are tested in accordance with standard procedures. 2.4 Final inspections are undertaken to ensure that the installed devices conforms to technical requirements. 2.5 Unplanned events or conditions are responded to in accordance with established procedures 2.6 Work site is cleaned and cleared of all debris and left safe in accordance with the company requirements 2.7 Report on installation and testing of equipment is prepared according to company's procedures/policies.
3. Diagnose faults and defects of industrial electronic modules/ products/systems	3.1 Systematic ***pre-testing procedure*** is observed in accordance with manufacturer's instructions. 3.2 System defects/Fault symptoms are identified using appropriate tools and equipment and ***troubleshooting techniques*** and in accordance with safety procedures 3.3 Test instruments required for the job are used in accordance with user manuals. 3.4 Circuits are checked and isolated using specified testing procedures 3.5 Identified defects and faults are explained to the ***responsible person*** in accordance with enterprise or company policy and procedures 3.6 Control settings/adjustments are checked in conformity with service-manual specifications. 3.7 Results of diagnosis and testing are documented accurately and completely within the specified time. 3.8 Customers are advised/informed regarding the status and serviceability of the unit according to procedures.

ELEMENT	PERFORMANCE CRITERIA (*Italicized bold* **terms are elaborated in the range of variables**)
4. Maintain/Repair industrial electronic products	4.1 Personal protective equipment is used in accordance with Occupational Health and Safety practices. 4.2 Electro-static discharge (ESD) protection procedure is followed in accordance with current industry standards. 4.3 Defective parts/components are replaced with identical or recommended appropriate equivalent ratings 4.4 Repaired or replaced parts/components are soldered/mounted in accordance with the current industry standards. 4.5 Control settings/adjustments are performed in conformity with service-manual specifications 4.6 Repair activity is performed within the required timeframe 4.7 Care and extreme precaution in handling the unit/product is observed as per OHS procedures 4.8 Cleaning of unit is performed in accordance with standard procedures 4.9 Excess components and materials are disposed of based on WEEE directives and 3Rs waste management program.
5. Reassemble and test repaired industrial electronic products	5.1 Repaired units are reassembled according to procedures 5.2 Reassembled units are subjected to final testing and cleaning in conformity with manufacturer's specifications 5.3 Service completion procedures and documentations are complied with based on manual. 5.4 Waste materials are disposed of in accordance with environmental requirements.

RANGE OF VARIABLES

VARIABLE	RANGE

1. Industrial electronics products and systems	Industrial electronics products and systems include --
	 1.1 Industrial Electronic Components
	 1.2 Industrial Electronic Product*
	    1.2.1 Control boards and modules
	    1.2.2 Motor controllers and drives
	    1.2.3 Sensors and input devices
	    1.2.4 Actuators and output devices
	    1.2.5 Opto-electronics equipment and devices
	
	 *** NOTE: Only the electronics portion of the products and/or systems is covered in this unit of competency.**

2. Service manuals	2.1 Service manual/schematic diagram/parts list 2.2 Operating instructions/User's/Owner's manual
3. Service Information	3.1 Job Report Sheets 3.2 Job Order 3.3 Bill of materials 3.4 Customer index 3.5 Service flowchart 3.6 Stock and inventory record 3.7 Requisition slips (for acquisition of parts) 3.8 Supplier Index
4. Tools, Materials and Test Instruments	May include but not limited to: 4.1 Variable power supply 4.2 Step-down transformer 4.3 Soldering iron/gun 4.4 Desoldering tools 4.5 Screwdriver (assorted) 4.6 Wrenches (assorted) 4.7 Allen wrench/key 4.8 Signal generator - AF/RF 4.9 Multi-testers (analog/digital) 4.10 Utility knife/stripper 4.11 Pliers (assorted) 4.12 Test jig 4.13 ESD-free work bench with mirror 4.14 Oscilloscope 4.15 High-grade magnifying glass with lamp 4.16 Flashlight 4.17 Cleaning brush 4.18 High voltage probe 4.19 Ball peen hammer 4.20 Soldering lead 4.21 Wires 4.22 Assorted industrial electronic components
5. Personal protective equipment	May include but not limited to: 5.1 Working clothes/Apron 5.2 Hand gloves 5.3 Face/Dust Mask 5.4 Goggles

VARIABLE	RANGE
6. Pre-testing procedures	6.1 Visual inspection of the unit with power off 6.2 Interview of customer re history of unit 6.3 Operate the unit according to manual to confirm defects
7. Troubleshooting techniques	May include: 7.1 Sensory methods • Visual checks • Listening for telltale sounds • Lookout for unusual smells • Touching or feeling 7.2 Component substitution 7.3 Signal injection and tracing 7.4 Voltage and current measurement 7.5 Continuity/resistance testing 7.6 Waveform analysis 7.7 Display analysis (for video displays) 7.8 Circuit analysis
8. Responsible persons	8.1 Immediate supervisor 8.2 Service supervisor/manager
9. OHS requirements in accordance with legislation & regulations	9.1 Use of proper tools and equipment 9.2 Observe workplace environment and safety 9.3 Adherence to safety requirements in handling the unit 9.4 Use of protective device/shields 9.5 Philippine Electronics Code
10. Environmental Requirements	10.1 Proper disposal of chemicals and components shall be based on existing requirements of the law and chemical waste management 10.2 Non-biodegradable parts or materials shall be packed and labeled properly for disposal.

EVIDENCE GUIDE

1	Critical aspects of competency	Assessment requires evidence that the candidate:
		1.1 Prepared unit, tools and workplace for installation/servicing
		1.2 Installed industrial electronics systems/products
		1.3 Diagnosed faults of industrial electronics systems/products
		1.4 Maintained/Repaired industrial electronics products
		1.5 Reassembled and tested repaired industrial electronics products
		1.6 Applied safety rules and procedures
2	Required knowledge and attitude	2.1 Mensuration/Mathematics
		2.1.1 Conversion of units
		2.1.2 Applied mathematics
		2.2 Drawing and Schematic Diagram
		2.2.1 Reading and interpreting orthographic projections and isometric views
		2.2.2 Reading and interpreting electronic schematic symbols and diagram
		2.3 Environment and Safety
		2.3.1 Work Safety requirements and economy of materials with durability
		2.3.2 Knowledge in 5S application and observation of required procedure
		2.3.3 Practicing 3Rs – reduce, re-use, recycle/recover
		2.3.4 Managing waste from electrical and electronic equipment (WEEE)
		2.4 Materials, tools/instruments & equipment uses and specifications
		2.4.1 Identification of hand and power tools
		2.4.2 Proper care and use of tools
		2.4.3 Identification of test and measuring instruments
		2.4.4 Proper care and use of test and measuring instruments
		2.5 Theories and Principles
		2.5.1 Differential amplifiers
		2.5.2 Analog to digital conversion
		2.5.3 Digital to analog conversion
		2.5.4 Solenoid Actuators
		2.5.5 Solid state relay
		2.5.6 LED
		2.5.7 Light sensor
		2.5.8 Lighting control system
		2.5.9 Temperature control system
		2.5.10 Temperature sensor
		2.5.11 Voltage and current control system
		2.5.12 Voltage/frequency and frequency conversion
		2.5.13 Timers
		2.5.14 Time control system
		2.5.15 Liquid level control system
		2.5.16 Optical sensor
		2.5.17 Fiber optic cable
		2.5.18 Fiber optic diode (tx and rx)
		2.5.19 Optical and touch control system
		2.5.20 Hall sensor
		2.5.21 Encoder/ decoder
		2.5.22 DC/ AC and brushless motor
		2.5.23 Stepping and servo motor

		2.5.24 Pulse Width Modulation
		2.5.25 Rotation control system
		2.5.26 Acoustic sensor
		2.5.27 Acoustic control system
		2.5.28 Teaching pendant
		2.5.29 Basic Robotic principles
		2.5.30 Ultrasonic sensor (tx and rx)
		2.5.31 Ultrasonic control system
		2.5.32 Infrared sensor
		2.5.33 Motion sensor
		2.5.34 Infrared control system
		2.5.35 Strain gage
		2.5.36 Pressure sensor
		2.5.37 Pressure control system
		2.5.38 Microcontroller
		2.5.39 Microcontroller interfacing
		
		2.6 3Rs waste management programs
		2.7 Consumer electronic products and systems installation procedures
		2.8 Systematic pre-testing procedures
		2.9 System defects/Fault symptoms
		2.10 Mechanical and electrical/electronic testing
		2.11 Rules and conventions
		
		     2.11.1 Philippine Electronics Code
		     2.11.2 RoHS/WEEE Directives
		     2.11.3 RA 9292 – ECE Law Commissioning procedures

3	Required skills	3.1 Application of troubleshooting technique 3.2 Using and maintaining test instruments, tools, & equipment 3.3 Application of work safety practices and time management 3.4 Application of substitution technique 3.5 Soldering/desoldering and wiring/cabling techniques 3.6 Schematic diagram reading skills
4	Method of assessment	Competency may be assessed through: 4.1 Practical Demonstration w/ oral questioning 4.2 Interview 4.3 Portfolio

5	Resource implications	The following resources must be provided:
		
		5.1 Tools, equipment and test instruments
		5.2 Access to Industrial electronic products and systems and work environment, e.g.
		     5.2.1 Control boards and modules
		     5.2.2 Motor controllers and drives
		     5.2.3 Sensors and input devices
		     5.2.4 Actuators and output devices
		     5.2.5 Opto-electronics equipment and devices
		     5.2.6 Data communication systems
		     5.2.7 Microcontroller-based equipment
		5.3 Service manuals/schematics
		5.4 ESD free working area/bench
		5.5 Complete electronic spare parts/supplies

6	Context of assessment	6.1 Assessment maybe conducted in the workplace or in a simulated workplace setting

SECTION 3   TRAINING STANDARDS

3.1   CURRICULUM DESIGN

Course Title: Electronic Products Assembly and Servicing   **NC Level:** NC II

Nominal Training Duration: 40 hrs – Basic Competencies
                                         80 hrs – Common Competencies
                                        140 hrs – Core Competencies
                                        ----
                                        260 hrs – TOTAL

Course Description:

       This course is designed to develop & enhance the knowledge, skills, & attitudes of an Electronic Products Technician, in accordance with industry standards. It covers the basic and common competencies in addition to the core competencies such as assembling electronic products, fabricating PCB modules and installing and servicing consumer and industrial electronic products and systems.

BASIC COMPETENCIES
40 hrs

Unit of Competency	Learning Outcome	Methodology	Assessment Approach
1. Participate in workplace communication	1.1 Obtain and convey workplace information. 1.2 Complete relevant work related documents. 1.3 Participate in workplace meeting and discussion.	Group discussion Interaction	• Demonstration • Observation • Interviews/ questioning
2. Work in a team environment	2.1 Describe and identify team role and responsibility in a team. 2.2 Describe work as a team member.	Discussion Interaction	• Demonstration • Observation • Interviews/ questioning
3. Practice career professionalism	3.1 Integrate personal objectives with organizational goals. 3.2 Set and meet work priorities. 3.3 Maintain professional growth and development.	Discussion Interaction	• Demonstration • Observation • Interviews/ questioning
4. Practice occupational health & safety	4.1 Identify hazards and risks. 4.2 Evaluate hazard and risks 4.3 Control hazards and risks 4.4 Maintain occupational health and safety awareness	Discussion Plant tour Symposium	• Observation • Interview

COMMON COMPETENCIES
80 hrs

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Apply Quality Standards	1.1 Assess quality of received materials 1.2 Assess own work 1.3 Engage in quality improvement	▪ Field trip ▪ Symposium ▪ Film showing ▪ Simulation ▪ On-the-job training	▪ Demonstration & questioning ▪ Observation & questioning ▪ Third party report
2. Perform Computer Operation	2.1 Plan and prepare for task to be undertaken 2.2 Input data into computer 2.3 Access information using computer 2.4 Produce output/data using computer system 2.5 Use basic functions of a web browser to locate information 2.6 Maintain computer equipment and systems	▪ Modular ▪ Film showing ▪ Computer-based training (e-learning) ▪ Project method ▪ On the job training	▪ Demonstration & questioning ▪ Observation & questioning ▪ Third party report ▪ Assessment of output product ▪ Portfolio ▪ Computer-based assessment
3. Use Hand Tools	3.1 Plan and prepare for task to be undertaken 3.2 Prepare hand tools 3.3 Use appropriate hand tools and equipment 3.4 Maintain hand tools	▪ Lecture / Demonstration ▪ Distance learning ▪ Film Showing	▪ Written/Oral examination ▪ Practical demonstration ▪ Observation and questioning
4. Perform Mensuration and Calculation	4.1 Select measuring instruments 4.2 Carry out measurement and calculation 4.3 Maintain measuring instruments	▪ Self-paced/ modular ▪ Demonstration ▪ Small group discussion ▪ Distance learning	▪ Written/Oral examination ▪ Practical demonstration
5. Prepare and Interpret Technical Drawings	5.1 Identify different kinds of technical drawings 5.2 Interpret technical drawing 5.3 Prepare/make changes on electrical/electronic schematic and drawings 5.4 Store technical drawings and equipment/ instruments	▪ Lecture/ demonstration ▪ Dualized training ▪ Distance learning	▪ Written /oral ▪ examinations ▪ Direct ▪ observation ▪ Project method ▪ interview

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
6. Terminate and Connect Electrical wiring and Electronic Circuits	6.1 Plan and prepare for termination/connection of electrical wiring/electronic circuits 6.2 Terminate/connect electrical wiring/electronic circuits 6.3 Test termination/ connection of electrical wiring /electronics circuits	▪ Film Viewing ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ On-the-Job Training ▪ Project Method	▪ Demonstration and Questioning ▪ Assessment of Output Product
7. Test electronic components	7.1 Determine criteria for testing electronics components 7.2 Plan an approach for component testing 7.3 Test components 7.4 Evaluate the testing process	▪ Film Viewing ▪ Individualized Learning ▪ Direct Student Laboratory Experience ▪ On-the-Job Training ▪ Project Method	▪ Demonstration and Questioning ▪ Assessment of Output Product

CORE COMPETENCIES
140 hrs

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Assemble Electronic Products	1.1 Prepare to assemble electronics products 1.2 Prepare/ Make PCB modules 1.3 Mount and solder electronic components 1.4 Assemble electronic products 1.5 Test and inspect assembled electronic products	▪ Lecture/ Discussion ▪ Demonstration ▪ Viewing multimedia ▪ Hands on practice ▪ Project making/ laboratory exercises ▪ Dual training ▪ Supervised-industry training ▪ eLearning/ Blended learning program	▪ Written exam ▪ Practical exam ▪ Observation in workplace ▪ Demonstration ▪ Portfolio
2. Service consumer electronic products and systems	2.1 Prepare unit, tools and workplace for installation and service 2.2 Install consumer electronic products and systems 2.3 Diagnose faults and defects consumer electronic products and systems 2.4 Maintain/Repair consumer electronic products 2.5 Re-assemble and test repaired consumer electronic products	▪ Lecture/Discussion ▪ Demonstration ▪ Viewing multimedia ▪ Hands on practice ▪ Simulation ▪ Dual training ▪ Supervised-industry training ▪ eLearning/ Blended learning program	▪ Written exam ▪ Practical exam ▪ Observation in workplace ▪ Demonstration ▪ Portfolio
3. Service industrial electronic modules, products and systems	3.1 Prepare unit, tools and workplace for installation and service 3.2 Install industrial electronic modules/products/systems 3.3 Diagnose faults and defects of industrial electronic modules/systems/products 3.4 Maintain/Repair industrial electronic products 3.5 Re-assemble and test repaired industrial electronics products	▪ Lecture ▪ Discussion ▪ Demonstration ▪ Viewing multimedia ▪ Hands on practice ▪ Simulation ▪ Dual training ▪ Supervised-industry training ▪ eLearning/ Blended learning program	▪ Written exam ▪ Practical exam ▪ Observation in workplace ▪ Demonstration ▪ Portfolio

3.2   TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery should be guided by the 10 basic principles of the competency-based TVET.

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is individualized and self-paced;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and the curriculum modules;
- Assessment is based in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Approved training programs are nationally accredited.

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 may be adopted when designing training programs:

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components.   Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.

- Modular/self-paced learning is a competency-based training modality wherein the trainee is allowed to progress at his own pace.   The trainer only facilitates the training delivery.

- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.

- Supervised industry training or on-the-job training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire a specific competencies prescribed in the training regulations.

- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructors are not in the same place.   Distance learning may employ correspondence study, or audio, video or computer technologies.

3.3 TRAINEE ENTRY REQUIREMENTS

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

- Must have completed at least 10 yrs. basic education or an ALS grade 10 certificate of rating holder
- Can communicate in oral and written language
- Can perform basic mathematical computations

This list does not include specific institutional requirements such as 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 (Institution-based)

Recommended list of tools, equipment and materials required in every workstation for Electronic Products Assembly and Servicing NC II:

TOOLS		EQUIPMENT		MATERIAL	
Qty.	Description	Qty.	Description	Qty.	Description
1 set	Pliers assorted, Long nose, Side cutter	1 unit	Multimeter *(analog/digital)*	1 spool	Soldering wire
1 set	Screw driver assorted, Phillips, slotted	1 set	Workshop table	50 ml	SMD soldering paste
1 set	Desoldering tools	1 set	High grade magnifying glass with lamp	500 ml	SMD soldering flux
1 set	Wrenches assorted	1 unit	Variable power supply	1 pc.	Cleaning brush
1 set	Allen wrench/key	1 unit	Variable transformer	1 bottle	Thinner/alcohol
1 pc	Utility knife/stripper			5ml	Thermal paste
1 set	Test jigs	1 unit	Hot air soldering station	1 bottle	Ferric chloride
1 pc	Wire stripper	1 unit	Oscilloscope, digital	5 units	Pale or water bucket
1 pc	Digital micrometer	1 unit	Signal generator	5m	Stranded/solid/ hook-up wires
1 pc	Anti-static strap	1 unit	Function generator	10m	wire stranded, #22, red
1 pc	Anti-static brush	1 unit	Electronically-controlled soldering station	10m	wire stranded, #22, black
1pc	Anti-static mat			10m	wire stranded, #22, white
1 set	Bread boards	***Recommended equipment (Optional):***		10m	wire stranded, #22, blue
		1 unit	Table top reflow oven	10m	wire stranded, #22, yellow
		1 unit	Lead-free soldering system	10m	wire stranded, #22, green
		1 set	ESD free work bench with mirror back-to-back/one-sided	10m	Solid wires, assorted color
				1 set	Assorted electronic components
				50 pcs	resistors (different values)
				50 pcs	capacitors (different values)

Note: *Tools, Equipment & Materials are on a per-workstation basis*

Equipment for consumer-electronics shop/laboratory -

Qty.	Description
EQUIPMENT	
1 lot	Audio-video product/appliance and component parts • Radio receivers • Audio recorders • Electronic musical instruments/keyboards • DVD/VCD player • Public-address (PA) systems • Television (Home/Portable) • PC monitors *Note:* The training provider registering the full qualification shall provide access to at least one (1) unit each of the above appliances/equipment for training purposes [i.e. demonstration, assembly, disassembly, trouble simulation].
1 lot	Domestic electronic-controlled appliances consisting of – • Electronic-controlled Washing Machines • Microwave Oven • Induction stove • Rechargeable light • Electronic-controlled air-conditioner/fan *Note:* The training provider registering the full qualification shall provide access to at least one (1) unit each of the above appliances/equipment for training purposes [i.e. demonstration, assembly, disassembly, trouble simulation].

Note: *As an alternative to the above arrangement where the training provider provides access to equipment (in-center or through partner-facility) the provider shall make available the following trainers/simulators within its premises -*
> *1 lot   trainer/simulator for radio-TV receivers*
> *1 lot   trainer/simulator for home security/CCTV system*
> *1 lot   trainer/simulator for domestic electronic appliance*
> > *• Microwave oven/ induction cooker*
> > *• Electronics controlled washing machine*
> > *• Ref and aircon control system*(optional*)*

Equipment for industrial electronics products and systems shop/laboratory -

Qty.	Description
EQUIPMENT	
1 lot	Industrial-electronics components
1 lot	Industrial-electronic product/device and component parts • Control boards and modules • Motor controllers and drives • Sensors and input devices • Actuators and output devices • Opto-electronics equipment and devices

Note: *The training provider may choose a specific industrial-electronics product/system with component/spare parts or a trainer/simulator for a specific industrial-electronics product/system (e.g., electronic motor controls system or an electronic surveillance system)*

3.5 TRAINING FACILITIES

Recommended space requirements for the various teaching/learning areas are as follows:

TEACHING/LEARNING/ FACILITIES AREAS	SIZE IN METERS	QTY	TOTAL AREA IN SQ. METERS
Lecture Area*	5 x 5	1	25
Workshop Area** (2trainees per Workstations) 1.5m x 2m	5 x 5 / 9 x 5	5 workstations / 10 workstations	25 / 45
Learning Resource Area	4 x 5	1	20
Tool Room/Storage Area	4 x 4	1	16
Wash ,Toilet & Locker Room	2 x 3	2	12
Sub- Total			98 / 118
Facilities / Equipment / Circulation***			30 / 36
Total Area		5 workstations / 10 workstations	128 / 154

* Optional (good for minimum of 10 trainees)
** For the workshop area (maximum of 20 trainees)
***Area requirement is equivalent to 30% of the total teaching/learning areas

3.6 TRAINERS QUALIFICATIONS

Electronic Products Assembly and Servicing NC II
Trainer's Qualification TQ I

- Holder of National TVET Trainer's Certificate (NTTC) Level 1
- * Must have at least 2-years relevant industry experience.

* Optional: Only when required by the hiring institution.

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.

As a matter of policy, graduates of programs registered with TESDA under these training regulations are required to undergo mandatory national competency assessment upon completion of the program.

SECTION 4: NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1 To attain the National Qualification of **Electronic Products Assembly and Servicing NC II**, the candidate must demonstrate competency in all the units listed in Section 1. Successful candidates shall be awarded a **National Certificate II** signed by the TESDA Director General.

4.2 The qualification of **Electronic Products Assembly and Servicing NC II** may be attained through:

    4.2.1 Accumulation of Certificates of Competency (COCs) in all the following units of competencies:

        4.2.1.1 Assemble electronic products
        4.2.1.2 Service consumer electronic products and systems
        4.2.1.3 Service industrial electronic modules, products and systems

        Successful candidates shall be awarded a **Certificate of Competency (COC)** in each of the core units.

4.3 For individuals, who already possess National Certificate (NC) or Certificate of Competency (COC) along Consumer Electronics Servicing NC II –

    4.3.1. Portfolio assessment is applicable for COC #1 and COC #2, provided the candidate is already employed and has related experience for the past three (3) years or more along the qualification. <u>However</u>, if the assessor finds the evidences presented inadequate, he may still require the candidate to undergo the practical demonstration or present other evidences in the form of Third Party Report, etc. depending on the need for supplementary evidences.

    4.3.2. Candidates are required to take assessment for COC #3 – "Service industrial electronic modules, products and systems".

4.4 Upon accumulation and submission of all COCs acquired for the relevant units of competency comprising a qualification, an individual shall be issued the corresponding National Certificate.

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

4.6 The following are qualified to apply for assessment and certification:

    4.6.1. Graduate of formal, non-formal, and informal, including enterprise-based, training programs.
    4.6.2. Experienced workers (wage employed or self employed)

4.7 The guidelines on assessment and certification are discussed in detail in the "Procedures Manual on Assessment and Certification" and "Guidelines on the Implementation of the Philippine TVET Qualification and Certification System (PTQCS)".

COMPETENCY MAP – ELECTRONIC PRODUCTS ASSEMBLY AND SERVICING NC II

BASIC COMPETENCIES

Receive & 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 & 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 & 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 Loops	Maintain and Repair Instrumentation & Control Devices
Start-up Instrumentation and Control Systems	Diagnose and Troubleshoot Instrumentation and Control Systems	Install Mechatronic Devices	Configure and Adjust Mechatronic Devices	Develop Mechatronic Control Circuits and Software Application Programs
Maintain and Repair Mechatronic Systems	Commission Mechatronic Systems	Diagnose and Troubleshoot Mechatronic 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
Assemble Electronic Products	**Service Consumer Electronic Products and Systems**	**Service Industrial Electronic Products and Systems**	Commission Consumer Electronic Products and Systems	Develop Servicing Systems for Consumer Electronic Products
Train service technician	Manage Servicing Systems for Consumer Electronic Products & Systems	Train service technician supervisors		

TRAINING REGULATIONS –ELECTRONIC PRODUCTS ASSEMBLY AND SERVICING NC II   Page 64

DEFINITION OF TERMS

GENERAL

1) **ALS (Alternative Learning System)** - It is a free education program implemented by the Department of Education (DepEd) under the Bureau of Alternative Learning System which benefits those who cannot afford formal schooling and follows whatever is their available schedule.

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

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

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

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

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

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

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

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

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

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

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

13) **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

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

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

16) **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

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

18) **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

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

20) **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

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

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

23) **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

24) **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

25) **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

26) **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. **Equipment -** A component part of an installation used for a particular purpose. Equipment includes, but is not limited to, that contained in the following divisions. It will necessarily include new and emerging technologies:

   • **Audio/visual equipment** including televisions, radios, monitors, cameras, closed circuit television, mono and stereo sound systems, gaming machines, electronic display panels, cassette recorders, video cassette recorders, CDROM players, tape recorders, sound and video duplication equipment, digital versatile discs, digital audio tapes, professional and domestic speaker systems, mixer desks.

   • **Appliances** including portable electric tools, motor driven pumps, vacuum cleaners, food preparation equipment, hair dryers, refrigerators, washing machines, dish washers, paper shredders, water coolers, clothes dryers, pest exterminators, electric motor driven industrial tools and equipment, sanitary disposal units, radial and tangential fans and blowers.

2. **Appliances -** A fixed (for support only), hand-held (held in hand during normal use), portable (moved whilst in operation or easily moved from one place to another while connected to the supply) or stationary (can be moved, but not easily) consuming device, other than a lamp.

3. **Competent person -** A person who has the relevant competencies described in this competency

4. **Component -** That portion of a unit of equipment, which has been designed as a discrete unit and that can be identified as such.

5. **Consumer electronics -** (abbreviated CE) are electronic equipment intended for everyday use, most often in entertainment, communications and office productivity. Consumer products include the broadcast receiver, personal computers, telephones, MP3 players, audio equipment, televisions, calculators, GPS automotive electronics, digital cameras and players and recorders using video media such as DVDs, VCRs or camcorders including large and small household appliances.

6. *Electronic components* - are generally intended to be connected together, usually by being soldered to a printed circuit board (PCB), to create an electronic circuit with a particular function (for example an amplifier, radio receiver, or oscillator). Components may be packaged singly, or in more complex groups as integrated circuits. Some common electronic components are capacitors, inductors, resistors, diodes, transistors, etc. Components are often categorized as active (e.g. transistors and thyristors) or passive *(e.g. resistors and capacitors).*

7. **Electronic products** – are generally referred as electronic consumer products such as large and small household appliances, televisions, audio/video machines including its accessories, digital receivers, phones, lightings, health care, and soon cameras, and video surveillance equipments.

8. **Environment -** The area surrounding the work site which can be directly or indirectly affected by occurrences at the work site. It includes the atmosphere, soils, drains, underground water tables, and the ecosystem. Protection of the environment would require the proper disposal of waste materials, restriction of burning off, the correct handling of toxic substances, the containment of CFCs and the like.

9. **Established procedures -** Formal arrangements of an organization, enterprise or statutory authority of how work is to be done.

10. **Hazardous materials -** Flammable gases and vapors and combustible dusts.

11. **Industrial Electronics** - the industry of making electronic products for industrial purposes

12. **Modifications -** To make changes to the physical parameters or operational function of a device, component or piece of equipment or apparatus.

13. **Notification (notified) -** Can include verbal, written, electronic or recorded information at completion of work which may be required to be completed in accordance with established procedures.

14. **OH&S policies and procedures -** Arrangements of an organization or enterprise to meet their legal and ethical obligations of ensuring the workplace is safe and without risk to health.

15. **Printed circuit boards (PCBs)** - is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. It is also referred to as **printed wiring board (PWB)** or **etched wiring board**. Printed circuit boards are used in virtually all but the simplest commercially produced electronic devices.

16. **Requirements -** That to which equipment and procedures and their outcomes must conform and includes statutory obligations and regulations and standards called-up by legislation or regulations.

17. **Servicing -** Undertaking routine inspection, repair and maintenance of circuits, systems or apparatus. Maintaining, fault finding and repair of equipment, plant and machinery.

18. **Standards -** Technical documents, which set out specifications and other criteria for equipment, materials, and methods to ensure they consistently, perform as intended.

19. **System -** A group or combination of inter-related, inter-dependent or interlocking elements forming a collective entity. Includes circuits, apparatus, equipment and the like.

20. **Termination -** The act by means of which an electrical connection to an apparatus is established; specifically a prepared joint or connection between a cable, cord or conductor and a point in an electrical circuit such as a terminal or connection point. Such terminations include soldering, crimping, clamping, wire wrapping, insulation piercing/compression.

21. **Testing devices -** Devices and instruments used to ensure safety requirements and operational functions are met, and to diagnose faults in apparatus, circuits or systems.

22. **WEEE Directives** - the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment.

23. **Wiring systems -** Permitted cables, enclosures, supports and accessories for power, measurement, control or communications purposes.

ACKNOWLEDGEMENTS

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

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