Skills for Employment Investment Program (SEIP)

COMPETENCY-BASED LEARNING MATERIAL

(FACULTY GUIDE)

FOR

ELECTRONCS

(LIGHT ENGINEERING SECTOR)

Finance Division, Ministry of Finance
Government of the People's Republic of Bangladesh

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Approval Sheet

Identification and validation of modules and content for this occupation were made by experts within this sector. A series of consultations were held to accurately capture industry and employer needs and expectations and develop the learning material that would help to enhance the employability of the youth trained. This process started on 4 November 2018 and concluded with a validation workshop with a sectoral working group on 27 March 2019.

Experts Involved

Industry and subject-matter experts who provided their valuable inputs to develop this competency-based learning material [November 2018 – April 2019]:

Name	Organisation	Designation
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Md. Masud Rana	BITAC	Executive Engineer
Abdul Haye	BUET	Instructor - Electronics
Md. Forhad Hossain	BCSIR	Engineer
Md. Shahidul Islam	DPI	Instructor
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Validation Workshop

Competency-based learning material validation workshop participants [held on 27 March 2019]:

Name	Organisation	Designation
Md. Ibrahim	MAWTS	Instructor
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Committee Workshop

The National competency-based learning material for National Skills Certificate in Electronics**, NTVQF Level [INSERT LEVEL]** qualification is a document developed by the Skill for Employment Investment Programme (SEIP), Finance Division, Ministry of Finance. This competency-based learning material has been developed by an industry expert group under guidance of SEIP. The competency-based learning material was approved by the SCDC [BTEB to insert date] at NTVQF Cell, BTEB.

Respectable members of the SCDC:

Electronics - Level [INSERT LEVEL]		

How to Use this Competency-based Learning Material

Welcome to the competency-based learning material for Electronics to use in light engineering works. These modules contain training materials and activities for learners to complete in order to become competent and qualified as a skilled worker.

There are five (5) modules that make up this course which comprises the skills, knowledge and attitudes required to become a skilled worker including:

1. Test electronic components
2. Connect and terminate electrical wiring and circuits
3. Assemble electronic products
4. Service consumer products and systems
5. Service industrial products and systems

As a trainer, you are required to guide the learners through a series of activities in order to complete each learning outcome of the module. These activities may be completed as part of structured classroom activities or they may be required to work at their own pace.

These activities will require the learners to complete associated learning and practice activities in order to gain knowledge and skills they need to achieve the learning outcomes. Refer to **Learning Activity Page of each module** to know the sequence of learning tasks and the appropriate resources to use for each task.

This page will serve as the road map towards the achievement of competence. If you read the **Information Sheets,** these will give you an understanding of the work, and why things are done the way they are. Once the learners have finished reading the Information Sheets, they are required to complete the questions in the **Self-Check Sheets**.

The self-check process follows the Information Sheets in the learning guide. Completing self-checks will help the learners know how they are progressing. To know how they fared with self-checks, they can review the **Answer Key**.

The learners are required to complete all activities as directed in the **Job Sheet**. This is where they will apply their newly acquired knowledge while developing new skills. When working, high emphasis should be laid on safety requirements. The learners should be encouraged to raise relevant queries or ask the facilitator for assistance as required.

When the learners have completed all the tasks required in the learning guide, an assessment event will be scheduled to evaluate if they have achieved competency of the specified learning outcomes and are ready for the next task.

Introduction to Teaching Adult Learners

Since you will be dealing with adult learners, it is important to understand the basic principles of adult learning and methodologies. Adults learn best through associations, experiences and application. A few facts to consider while teaching adult learners:

Discussion: Adult learning is best managed through mutual dialogue and discussion. Discussion needs to be encouraged and used in the classroom to maximise learning.

Associations: Adults have experiences which can be related to any learning objectives to create associations which enhance conceptual comprehension. Associations can be used to create user interest and gain attention. Adults learn new attitudes or skills best in relation to previous life experiences.

This strategy also ensures knowledge retention.

Create an environment conducive to learning and sharing: Make people feel comfortable talking to you and each other. They should feel at ease asking questions, sharing views even if they are not very sure of the efficacy of their suggestions or views.

Physical surroundings: Temperature, light, space and furniture should be optimal. There should be no distractions.

Inculcate respect: Encourage learners' contributions and experiences. People are more encouraged to learn and share when their experiences are acknowledged - new information builds easily on past knowledge and experience.

Reward and recognition: Acknowledging the efforts of people, even small attempts, can reap great benefits. Learners like to receive praise and positive encouragement, which motivates them to deliver their best.

Learners also like to be reassured that they are correctly recalling or using information they have absorbed in the classroom.

Structured teaching: Learners study faster when information or skills are presented in a structured way**:**

- Concepts to be taught in small, bite sized portions for easy assimilation
- Put forth the easiest ideas or skills first and then gradually build on them
- Bring in the important ideas first
- Reinforce key ideas at regular intervals
- Reinforce high order concepts at regular intervals

Move learner from generic to specific flow of information: Introduce the generic concepts first and then move to specific more complex information to ease understanding and comprehension.

Application of concepts/ideas taught: Help students put into practice the concepts taught in the class through exercises and work-based projects. Application ensures knowledge retention and skill building.

Relevance building: Build up relevance of the concepts being taught in class by relating them to day-to-day life and workplace experiences.

Learners should know to use and apply what they have learned in the classroom as they learn faster when they recognise that what they are learning will be useful in the future.

Sharing: Encourage learners to learn from each other and solve problems collectively. This makes learning easier and improves team spirit and the interpersonal skills of the learners.

Participation: Involve learners in the class - adults favour to be *active participants* in learning rather than passive receivers of knowledge. People learn faster when they actively process information, solve problems and practice skills.

Motivate: Inspire the class so that teaching does not become a one-way process of knowledge download. Learners will learn faster when they feel an inner urge to learn and be an active participant in the class.

Create a learning environment in which the learners feel free and able to shed their inhibitions and develop receptivity towards new ideas and concepts.

Students will have different motivation levels - some will be more eager to learn than others as each leaner is different from the other and therefore need to be treated differently.

And remember - adapt your communication style to suit the needs of the audience.

Communicate effectively: Communicate in a manner that is understood by the class. The language and sentence structuring should be clear and succinct.

Technical concepts should be explained in a manner that de-mystifies the concept - make things simple and easy to understand.

Avoid using *too much* technical jargon - if it is part of the curriculum, ensure the class is first made familiar with the words or jargon used.

Assessments: Conduct skill and knowledge checks regularly:

- Reinforce high order concepts at regular intervals.
- Conduct formative and summative assessments.
- Strengthen areas which appear to be weak.

Regular feedback:

- Provide regular feedback to learners
- Help them identify their strengths and areas of improvement
- Feedback should always be constructive
- Timely and specific feedback is easier to accept and act on

List of Icons

Icon Name	Icon
Module content	
Learning outcomes	
Performance criteria	
Contents	
Assessment criteria	
Resources required	
Information sheet	
Self-check Quiz	
Answer key	
Activity	
Video reference	
Learner job sheet	
Assessment plan	
Review of competency	

Module 1: Test electronic components

Module Descriptor:	This module covers the skills, knowledge and attitudes required to test electronic components. It specifically includes identifying basic electronic components, determining testing criteria, planning testing approach, and testing components.	
Nominal Duration:	40 hours	
Learning Outcomes:	**1.1.**	Identify basic electronic components
	1.2.	Determine testing criteria.
	1.3.	Plan testing approach.
	1.4.	Test components
Performance Criteria:	**1.1.**	Different components are identified and described.
	1.2.	Symbols of different components are identified.
	1.3.	Different terminals are identified and described.
	1.4.	Work instructions are obtained and clarified based on client requirements.
	1.5.	Responsible person is consulted for effective and proper work coordination.
	1.6.	Data sheets are obtained and interpreted based on manufacturers specifications.
	1.7.	Testing criteria is defined to ensure components meet technical and quality requirements.
	1.8.	Document and communicate testing criteria to relevant personnel.
	1.9.	Testing method is identified based on type of electronic component.
	1.10.	Characteristics of testing method to be used are determined.
	1.11.	Testing method is selected pursuant to testing strategy.
	1.12.	Plan for testing components is developed and documented.
	1.13.	Tools and testing devices are prepared and checked as per standard operating procedure.
	1.14.	Recording system is established to document testing results, including problems and faults.
	1.15.	Component testing is carried out to ensure products meet creative, production and technical requirements.
	1.16.	Problems, faults and remedial steps required are documented in records system.
	1.17.	Problems and faults are resolved in accordance with standard operating procedure.
	1.18.	Products are evaluated against testing criteria.
	1.19.	Testing process is reported to relevant personnel.

Learning Outcome 1.1 - Identify Basic Electronic Components

<table>
<tr><td>Contents:</td><td colspan="3">▪ Identify and describe different components
▪ Identify symbols of different components
▪ Identify and describe different terminals</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Basic electronic components
▪ Stationery
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
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▪ Self-Check 1.1.1
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27</td></tr>
<tr><td>1.1.2</td><td>▪ Information Sheet 1.1.2
▪ Self-Check Quiz 1.1.2
▪ Answer Key 1.1.2</td><td>10
10
27</td></tr>
<tr><td>1.1.3</td><td>▪ Information Sheet 1.1.3
▪ Self-Check Quiz 1.1.3
▪ Answer Key 1.1.3</td><td>11
11
27</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Different components are identified and described.
▪ Symbols of different components are identified.
▪ Different terminals are identified and described.</td></tr>
</table>

Learning Outcome 1.2 - Determine Testing Criteria

<table>
<tr><td>Contents:</td><td colspan="3">▪ Work instructions are obtained and clarified based on client requirements.
▪ Data sheets are obtained and interpreted based on manufacturers specifications.
▪ Testing criteria is defined to ensure components meet technical and quality requirements</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Stationery
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>1.2.1</td><td>▪ Information Sheet 1.2.1
▪ Self-Check Quiz 1.2.1
▪ Answer Key 1.2.1</td><td>12
13
27</td></tr>
<tr><td>1.2.2</td><td>▪ Information Sheet 1.2.2
▪ Self-Check Quiz 1.2.2
▪ Answer Key 1.2.2</td><td>14
14
27</td></tr>
<tr><td>1.2.3</td><td>▪ Information Sheet 1.2.3
▪ Self-Check Quiz 1.2.3
▪ Answer Key 1.2.3</td><td>15
15
27</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Obtain and clarify work instructions based on client requirements.
▪ Obtain and interpret data sheets based on manufacturers specifications.
▪ Define testing criteria to ensure components meet technical and quality requirements.</td></tr>
</table>

Learning Outcome 1.3 - Plan Testing Approach

<table>
<tr><td>Contents:</td><td colspan="3">▪ Define testing method based on type of electronic component
▪ Prepare and check tools and testing devices as per standard operating procedure
▪ Establish recording system to document testing results, including problems and faults</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>1.3.1</td><td>▪ Information Sheet 1.3.1
▪ Self-Check Quiz 1.3.1
▪ Answer Key 1.3.1</td><td>17
18
27</td></tr>
<tr><td>1.3.2</td><td>▪ Information Sheet 1.3.2
▪ Self-Check Quiz 1.3.2
▪ Answer Key 1.3.2</td><td>18
19
27</td></tr>
<tr><td>1.3.3</td><td>▪ Information Sheet 1.3.3
▪ Self-Check Quiz 1.3.3
▪ Answer Key 1.3.3</td><td>20
20
27</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Testing method is identified based on type of electronic component.
▪ Tools and testing devices are prepared and checked as per standard operating procedure.
▪ Recording system is established to document testing results, including problems and faults.</td></tr>
</table>

Learning Outcome 1.4 - Testing Components

<table>
<tr><td>Contents:</td><td colspan="3">▪ Problems, faults and remedial steps required are documented in records system
▪ Problems and faults are resolved in accordance with standard operating procedure</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Testing equipment
▪ Electrical materials and components
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="3">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>1.4.1</td><td>▪ Information Sheet 1.4.1
▪ Self-Check Quiz 1.4.1
▪ Answer Key 1.4.1</td><td>21
23
27</td></tr>
<tr><td>1.4.2</td><td>▪ Information Sheet 1.4.2
▪ Self-Check Quiz 1.4.2
▪ Job Sheet 1
▪ Answer Key 1.4.2</td><td>24
25
26
27</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Document problems, faults and remedial steps required in records system.
▪ Resolve problems and faults in accordance with standard operating procedure.</td></tr>
</table>

Module 2: Connect and terminate electrical wiring and circuits

Module Descriptor:	This module covers the skills, knowledge and attitudes required to connect and terminate electrical wiring and circuits. It specifically includes identifying measuring devices and accessories, preparing for connection and termination, performing connection and termination, carrying out soldering, and testing connection and termination of electrical wiring and circuits.	
Nominal Duration:	40 hours	
Learning Outcomes:	**2.1.**	Identify measuring devices and accessories
	2.2.	Prepare for connection and termination
	2.3.	Perform connection and termination
	2.4.	Carry out soldering
	2.5.	Test connection and termination
Performance Criteria:	**2.1.**	Measuring devices and accessories are identified.
	2.2.	Measuring devices and accessories are collected and checked.
	2.3.	Materials are checked according to job specification.
	2.4.	Appropriate tools and equipment are selected as per job requirement.
	2.5.	Job requirement is planned as per standard operating procedure.
	2.6.	Electrical wiring and electronic circuits are prepared for connection/termination as per job requirement.
	2.7.	Appropriate ranges of methods in connection/termination are employed as per job and manufacturers specification.
	2.8.	Correct sequence of operation is followed according to job specification and standard operating procedure.
	2.9.	Accessories are adjusted as per job specification, if necessary.
	2.10.	Confirmation of connection/termination is undertaken to ensure quality completion of job as per job specification.
	2.11.	Components are mounted and soldered in accordance with soldering principles.
	2.12.	Soldered components are checked to ensure compliance with international standards and job requirement.
	2.13.	Testing of completed connections/terminations is carried out to ensure compliance.
	2.14.	Wiring and circuits are checked using specified testing procedures.
	2.15.	Unplanned events or conditions are responded to in accordance with standard operating procedure.

Learning Outcome 2.1 - Identify Measuring Devices and Accessories

Contents:	▪ Identify measuring devices and accessories		
Resources Required:	▪ Workplace (simulated or actual) ▪ Relevant drawings, manuals, codes, standards and reference material ▪ Tools and equipment (measuring) ▪ Accessories ▪ Instruction sheet/manual ▪ Personal protective equipment (PPE)		
Learning Activities:	**Activity**	**Resource**	**Student Guide Page**
	2.1.1	▪ Information Sheet 2.1.1 ▪ Self-Check Quiz 2.1.1 ▪ Answer Key 2.1.1	29 22 41
Assessment Criteria:	▪ Measuring devices and accessories are identified.		

Learning Outcome 2.2 - Prepare for Connection and Termination

Contents:	▪ Check materials according to job specification ▪ Select appropriate tools and equipment as per job requirement ▪ Prepare electrical wiring and electronic circuits for connection/termination as per job requirement		
Resources Required:	▪ Workplace (simulated or actual) ▪ Relevant drawings, manuals, codes, standards and reference material ▪ Tools and equipment ▪ Electrical materials and components ▪ Instruction sheet/manual ▪ Personal protective equipment (PPE)		
Learning Activities:	**Activity**	**Resource**	**Student Guide Page**
	2.2.1	▪ Information Sheet 2.2.1 ▪ Self-Check Quiz 2.2.1 ▪ Answer Key 2.2.1	31 32 41
	2.2.2	▪ Information Sheet 2.2.2 ▪ Self-Check Quiz 2.2.2 ▪ Answer Key 2.2.2	33 34 41
	2.2.3	▪ Information Sheet 2.2.3 ▪ Self-Check Quiz 2.2.3 ▪ Answer Key 2.2.3	34 35 41
Assessment Criteria:	▪ Materials are checked according to job specification. ▪ Appropriate tools and equipment are selected as per job requirement. ▪ Electrical wiring and electronic circuits are prepared for connection/termination as per job requirement.		

Learning Outcome 2.3 - Perform Connection and Termination

<table>
<tr><td>Contents:</td><td colspan="3">▪ Employ appropriate ranges of methods in connection/termination as per job and manufacturers specification</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>2.3.1</td><td>▪ Information Sheet 2.3.1
▪ Self-Check Quiz 2.3.1
▪ Answer Key 2.3.1</td><td>36
37
41</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Appropriate ranges of methods in connection/termination are employed as per job and manufacturers specification.</td></tr>
</table>

Learning Outcome 2.4 - Carry Out Soldering

<table>
<tr><td>Contents:</td><td colspan="3">▪ Mount components and solder in accordance with soldering principles</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Soldering equipment and materials
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>2.4.1</td><td>▪ Information Sheet 2.4.1
▪ Self-Check Quiz 2.4.1
▪ Job Sheet 2
▪ Answer Key 2.4.1</td><td>38
39
40
41</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Components are mounted and soldered in accordance with soldering principles.</td></tr>
</table>

Module 3: Assemble electronic products

Module Descriptor:	This module covers the skills, knowledge and attitudes required to assemble electronic products. It specifically includes preparing to assemble products, preparing printed circuit board (PCB) modules, mounting and soldering components, performing assembly, and testing and inspecting products.	
Nominal Duration:	40 hours	
Learning Outcomes:	**3.1.**	Prepare for assemble products
	3.2.	Prepare printed circuit board (PCB) modules
	3.3.	Mount and solder components
	3.4.	Perform assembly
	3.5.	Test and inspect products
Performance Criteria:	**3.1.**	Assembly workplace is prepared as per standard operating procedure.
	3.2.	Work instructions are obtained and clarified based on client requirements.
	3.3.	Responsible person is consulted for effective and proper work coordination.
	3.4.	Tools and equipment are prepared and checked in accordance with job requirement.
	3.5.	Materials are prepared and checked in accordance with job requirement.
	3.6.	Parts and components needed are identified and prepared as per job requirement.
	3.7.	Printed circuit board (PCB) layout is checked for conformity with schematic diagram as per layout rules.
	3.8.	PCB layout is transferred to copper-cladded board per acceptable method.
	3.9.	Thru-hole is drilled and PCB is cleaned.
	3.10.	PCB functionality is tested and visual inspection is carried out.
	3.11.	Mounting technique is identified and selected.
	3.12.	Components are mounted and soldered in accordance with soldering principles.
	3.13.	Soldered components are checked to ensure compliance with international standards and job requirement.
	3.14.	Assembly procedures are carried out as per standard operating procedure.
	3.15.	Modules and accessories are connected into final product as per job specification.
	3.16.	Excess components and materials are disposed of pursuant to waste management procedure.

	3.17.	Testing and inspection of finished products is carried out in accordance with quality standards and standard operating procedure.
	3.18.	Job completion is recorded and reported as per standard operating procedure.

Learning Outcome 3.1 - Prepare to Assemble Products

<table>
<tr><td>Contents:</td><td colspan="3">▪ Prepare and check tools and equipment in accordance with job requirement</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>3.1.1</td><td>▪ Information Sheet 3.1.1
▪ Self-Check Quiz 3.1.1
▪ Answer Key 3.1.1</td><td>44
45
57</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Tools and equipment are prepared and checked in accordance with job requirement.</td></tr>
</table>

Learning Outcome 3.2 – Prepare Printed Circuit Board (PCB) Modules

Contents:	▪ Transfer PCB layout to copper-clad board per acceptable method		
Resources Required:	▪ Workplace (simulated or actual) ▪ Relevant drawings, manuals, codes, standards and reference material ▪ Tools and equipment ▪ Electrical materials and components ▪ PCB ▪ Instruction sheet/manual ▪ Personal protective equipment (PPE)		
Learning Activities:	**Activity**	**Resource**	**Student Guide Page**
	3.2.1	▪ Information Sheet 3.2.1 ▪ Self-Check Quiz 3.2.1 ▪ Answer Key 3.2.1	46 47 57
Assessment Criteria:	▪ PCB layout is transferred to copper-cladded board per acceptable method.		

Learning Outcome 3.3 – Mount and Solder Components

Contents:	▪ Mount and solder components in accordance with soldering principles		
Resources Required:	▪ Workplace (simulated or actual) ▪ Relevant drawings, manuals, codes, standards and reference material ▪ Tools and equipment ▪ Soldering equipment and materials ▪ Electrical materials and components ▪ Instruction sheet/manual ▪ Personal protective equipment (PPE)		
Learning Activities:	**Activity**	**Resource**	**Student Guide Page**
	3.3.1	▪ Information Sheet 3.3.1 ▪ Self-Check Quiz 3.3.1 ▪ Answer Key 3.3.1	48 50 57
Assessment Criteria:	▪ Components are mounted and soldered in accordance with soldering principles.		

Learning Outcome 3.4 - Perform Assembly

<table>
<tr><td>Contents:</td><td colspan="3">▪ Connect modules and accessories into final product as per job specification</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electronic materials and components
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>3.4.1</td><td>▪ Information Sheet 3.4.1
▪ Self-Check Quiz 3.4.1
▪ Answer Key 3.4.1</td><td>51
53
57</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Modules and accessories are connected into final product as per job specification.</td></tr>
</table>

Learning Outcome 3.5 - Test and Inspect Products

Contents:	▪ Carrey out testing and inspection of finished products in accordance with quality standards and standard operating procedure		
Resources Required:	▪ Workplace (simulated or actual) ▪ Relevant drawings, manuals, codes, standards and reference material ▪ Tools and equipment ▪ Testing equipment ▪ Electronic products ▪ Instruction sheet/manual ▪ Personal protective equipment (PPE)		
Learning Activities:	**Activity**	**Resource**	**Student Guide Page**
	3.5.1	▪ Information Sheet 3.5.1 ▪ Self-Check Quiz 3.5.1 ▪ Job Sheet 3 ▪ Answer Key 3.5.1	54 55 56 57
Assessment Criteria:	▪ Test and inspect of finished products is carried out in accordance with quality standards and standard operating procedure.		

Module 4: Service consumer products and systems

Module Descriptor:	This module covers the skills, knowledge and attitudes required to service consumer products and systems. It specifically includes preparing for work, installing products and systems, diagnosing faults and defects, repairing products and systems, and testing products and systems.	
Nominal Duration:	60 hours	
Learning Outcomes:	**4.1.**	Prepare for work
	4.2.	Install products and systems
	4.3.	Diagnose faults and defects
	4.4.	Repair products and systems
	4.5.	Test products and systems
Performance Criteria:	**4.1.**	Consumer products and systems are checked and defects are identified, verified and recorded against customer description.
	4.2.	Service manuals and information required for installation are identified.
	4.3.	Repair and maintenance history are confirmed with consumer as per standard operating procedure.
	4.4.	Workplace is prepared for installation as per job requirement.
	4.5.	Tools and equipment are identified and selected as per job requirement.
	4.6.	Materials are identified and obtained as per job requirement.
	4.7.	Products and systems are installed in accordance with manufacturer's instructions.
	4.8.	Products and systems are tested and inspected as per standard operating procedure.
	4.9.	Unplanned events or conditions are responded to in accordance with standard operating procedure.
	4.10.	Report on installation and testing of equipment is prepared as per organisational policy.
	4.11.	Workplace is cleaned and cleared of all debris.
	4.12.	Troubleshooting techniques are identified.
	4.13.	Pre-testing procedure is carried out as per manufacturer's instructions.
	4.14.	Circuits are checked and isolated using as per standard operating procedure.
	4.15.	System defects or fault symptoms are identified using appropriate troubleshooting technique.
	4.16.	Control settings and adjustments are checked to ensure compliance with service-manual specifications.
	4.17.	Results of diagnosis and testing are recorded accurately.
	4.18.	Customer is informed of status and serviceability of product or system.

	4.19.	Electro-static discharge (ESD) protection procedure is followed in accordance with industry standards.
	4.20.	Defective parts are repaired or replaced as per manufacturer's instructions.
	4.21.	Repaired or replaced parts are mounted and soldered as per job requirement.
	4.22.	Control settings and adjustments are checked to ensure compliance with service-manual specifications.
	4.23.	Repaired product or system is reassembled.
	4.24.	Product or system is cleaned as per standard operating procedure.
	4.25.	Workplace is cleaned and cleared of all debris.
	4.26.	Product or system is tested and inspected in accordance with quality standards and standard operating procedure.
	4.27.	Job completion is recorded and reported as per standard operating procedure.

Learning Outcome 4.1 - Prepare for Work

<table>
<tr><td>Contents:</td><td colspan="3">▪ Check and identify defects, verify and record consumer products and systems against customer description
▪ Identify and select tools and equipment as per job requirement</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Consumer products
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="3">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>4.1.1</td><td>▪ Information Sheet 4.1.1
▪ Self-Check Quiz 4.1.1
▪ Answer Key 4.1.1</td><td>60
62
75</td></tr>
<tr><td>4.1.2</td><td>▪ Information Sheet 4.1.2
▪ Self-Check Quiz 4.1.2
▪ Answer Key 4.1.2</td><td>63
63
75</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Consumer products and systems are checked and defects are identified, verified and recorded against customer description.
▪ Repair and maintenance history are confirmed with consumer as per standard operating procedure.
▪ Tools and equipment are identified and selected as per job requirement.</td></tr>
</table>

Learning Outcome 4.2 - Install Products and Systems

<table>
<tr><td>Contents:</td><td colspan="3">▪ Identify and obtain materials as per job requirement
▪ Test and inspect products and systems as per standard operating procedure
▪ Prepare report on installation and testing of equipment as per organisational policy</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Testing equipment
▪ Electrical materials and components
▪ Consumer products and systems
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>4.2.1</td><td>▪ Information Sheet 4.2.1</td><td>31</td></tr>
<tr><td>4.2.2</td><td>▪ Information Sheet 4.2.2</td><td>54</td></tr>
<tr><td>4.2.3</td><td>▪ Information Sheet 4.2.3</td><td>15</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Materials are identified and obtained as per job requirement.
▪ Products and systems are tested and inspected as per standard operating procedure.
▪ Report on installation and testing of equipment is prepared as per organisational policy.</td></tr>
</table>

Learning Outcome 4.3 - Diagnose Faults and Defects

<table>
<tr><td>Contents:</td><td colspan="3">▪ Identify troubleshooting techniques
▪ Carry out pre-testing procedure as per manufacturer’s instructions
▪ Check and isolate circuits using as per standard operating procedure</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electronic materials and components
▪ Consumer products and systems
▪ Testing equipment
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>4.3.1</td><td>▪ Information Sheet 4.3.1</td><td>21</td></tr>
<tr><td>4.3.2</td><td>▪ Information Sheet 4.3.2</td><td>15</td></tr>
<tr><td>4.3.3</td><td>▪ Information Sheet 4.3.3
▪ Self-Check Quiz 4.3.3
▪ Answer Key</td><td>68
71
75</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Troubleshooting techniques are identified.
▪ Pre-testing procedure is carried out as per manufacturer’s instructions.
▪ Circuits are checked and isolated using as per standard operating procedure.</td></tr>
</table>

Learning Outcome 4.4 - Repair Products and Systems

<table>
<tr><td>Contents:</td><td colspan="3">▪ Repair or replace defective parts as per manufacturer’s instructions</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Consumer products and systems
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>4.4.1</td><td>▪ Information Sheet 4.4.1</td><td>24</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Defective parts are repaired or replaced as per manufacturer’s instructions.</td></tr>
</table>

Learning Outcome 4.5 - Test Products and Systems

<table>
<tr><td>Contents:</td><td colspan="3">▪ Carry out testing and inspection of finished products in accordance with quality standards and standard operating procedure</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Consumer products and systems
▪ Testing equipment
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>4.5.1</td><td>▪ Information Sheet 4.5.1
▪ Job Sheet 4</td><td>54
74</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Test and inspect of finished products is carried out in accordance with quality standards and standard operating procedure.</td></tr>
</table>

Module 5: Service industrial products and systems

Module Descriptor:	This module covers the skills, knowledge and attitudes required to service industrial products and systems. It specifically includes preparing for work, installing products and systems, diagnosing faults and defects, repairing products and systems, and testing products and systems.	
Nominal Duration:	60 hours	
Learning Outcomes:	**5.1.**	Prepare for work
	5.2.	Install products and systems
	5.3.	Diagnose faults and defects
	5.4.	Repair products and systems
	5.5.	Test products and systems
Performance Criteria:	**5.1.**	Industrial products and systems are checked and defects are identified, verified and recorded against customer description.
	5.2.	Service manuals and information required for installation are identified.
	5.3.	Repair and maintenance history are confirmed with consumer as per standard operating procedure.
	5.4.	Workplace is prepared for repair as per job requirement.
	5.5.	Tools and equipment are identified and selected as per job requirement.
	5.6.	Materials are identified and obtained as per job requirement.
	5.7.	Products and systems are installed in accordance with manufacturer's instructions.
	5.8.	Products and systems are tested and inspected as per standard operating procedure.
	5.9.	Unplanned events or conditions are responded to in accordance with standard operating procedure.
	5.10.	Report on installation and testing of equipment is prepared as per organisational policy.
	5.11.	Workplace is cleaned and cleared of all debris.
	5.12.	Troubleshooting techniques are identified.
	5.13.	Pre-testing procedure is carried out as per manufacturer's instructions.
	5.14.	Circuits are checked and isolated using as per standard operating procedure.
	5.15.	System defects or fault symptoms are identified using appropriate troubleshooting technique.
	5.16.	Control settings and adjustments are checked to ensure compliance with service-manual specifications.
	5.17.	Results of diagnosis and testing are recorded accurately.
	5.18.	Customer is informed of status and serviceability of product or system.

	5.19.	Electro-static discharge (ESD) protection procedure is followed in accordance with industry standards.
	5.20.	Defective parts are repaired or replaced as per manufacturer's instructions.
	5.21.	Repaired or replaced parts are mounted and soldered as per job requirement.
	5.22.	Control settings and adjustments are checked to ensure compliance with service-manual specifications.
	5.23.	Repaired product or system is reassembled.
	5.24.	Product or system is cleaned as per standard operating procedure.
	5.25.	Workplace is cleaned and cleared of all debris.
	5.26.	Product or system is tested and inspected in accordance with quality standards and standard operating procedure.
	5.27.	Job completion is recorded and reported as per standard operating procedure.

Learning Outcome 5.1 - Prepare for Work

<table>
<tr><td>Contents:</td><td colspan="3">▪ Check industrial products and systems and identify, verify and record defects against customer description
▪ Identify and select tools and equipment as per job requirement</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Industrial products and systems
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="3">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>5.1.1</td><td>▪ Information Sheet 5.1.1
▪ Self-Check Quiz 5.1.1
▪ Answer Key 5.1.1</td><td>78
79</td></tr>
<tr><td>5.1.2</td><td>▪ Information Sheet 5.1.2</td><td>63</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Industrial products and systems are checked and defects are identified, verified and recorded against customer description.
▪ Tools and equipment are identified and selected as per job requirement.</td></tr>
</table>

Learning Outcome 5.2 - Install Products and Systems

<table>
<tr><td>Contents:</td><td colspan="3">▪ Identify and obtain materials as per job requirement
▪ Test and inspect products and systems as per standard operating procedure
▪ Prepare report on installation and testing of equipment as per organisational policy</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Industrial products and systems
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>5.2.1</td><td>▪ Information Sheet 5.2.1</td><td>31</td></tr>
<tr><td>5.2.2</td><td>▪ Information Sheet 5.2.2</td><td>54</td></tr>
<tr><td>5.2.3</td><td>▪ Information Sheet 5.2.3</td><td>15</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Materials are identified and obtained as per job requirement.
▪ Products and systems are tested and inspected as per standard operating procedure.
▪ Report on installation and testing of equipment is prepared as per organisational policy.</td></tr>
</table>

Learning Outcome 5.3 - Diagnose Faults and Defects

<table>
<tr><td>Contents:</td><td colspan="3">▪ Identify troubleshooting techniques
▪ Carry out pre-testing procedure as per manufacturer’s instructions
▪ Check and isolate circuits using as per standard operating procedure</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Industrial products and systems
▪ Testing equipment
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="4">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>5.3.1</td><td>▪ Information Sheet 5.3.1</td><td>21</td></tr>
<tr><td>5.3.2</td><td>▪ Information Sheet 5.3.2</td><td>15</td></tr>
<tr><td>5.3.3</td><td>▪ Information Sheet 5.3.3</td><td>67</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Troubleshooting techniques are identified.
▪ Pre-testing procedure is carried out as per manufacturer’s instructions.
▪ Circuits are checked and isolated using as per standard operating procedure.</td></tr>
</table>

Learning Outcome 5.4 - Repair Products and Systems

Contents:	▪ Repair or replace defective parts as per manufacturer's instructions		
Resources Required:	▪ Workplace (simulated or actual) ▪ Relevant drawings, manuals, codes, standards and reference material ▪ Tools and equipment ▪ Electrical materials and components ▪ Industrial products and systems ▪ Instruction sheet/manual ▪ Personal protective equipment (PPE)		
Learning Activities:	**Activity**	**Resource**	**Student Guide Page**
	5.4.1	▪ Information Sheet 5.4.1	24
Assessment Criteria:	▪ Defective parts are repaired or replaced as per manufacturer's instructions		

Learning Outcome 5.5 - Test Products and Systems

<table>
<tr><td>Contents:</td><td colspan="3">▪ Carry out testing and inspection of finished products in accordance with quality standards and standard operating procedure</td></tr>
<tr><td>Resources Required:</td><td colspan="3">▪ Workplace (simulated or actual)
▪ Relevant drawings, manuals, codes, standards and reference material
▪ Tools and equipment
▪ Electrical materials and components
▪ Industrial products and systems
▪ Testing equipment
▪ Instruction sheet/manual
▪ Personal protective equipment (PPE)</td></tr>
<tr><td rowspan="2">Learning Activities:</td><td>Activity</td><td>Resource</td><td>Student Guide Page</td></tr>
<tr><td>5.5.1</td><td>▪ Information Sheet 5.5.1
▪ Job Sheet 5</td><td>54
86</td></tr>
<tr><td>Assessment Criteria:</td><td colspan="3">▪ Test and inspect of finished products is carried out in accordance with quality standards and standard operating procedure.</td></tr>
</table>