National Vocational Certificate

Level 2 in

Electrical Technology (Building Electricity)

CBT Curriculum

Version 1

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NATIONAL VOCATIONAL & TECHNICAL TRAINING COMMISSION

NAVTTC نیوٹک

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Contents

1. Introduction

The construction industry is one of the leading businesses in Pakistan as well as in Middle East and other part of the world. Building Electricians play a vital role in the installation and maintenance of electrical appliances. The increased use of solar energy has further added to the demand of building electricians having the skills to install and maintain solar photovoltaic systems, thus, meeting the ever-growing demand of industry. This course has been design and developed to achieve its objectives of providing appropriate skills.

1.1 Overall course objective

The aim of this programme is to produce employable Building Electrician (Assistant) who could provide intermediate installation and maintenance services of electrical appliance, includingoff-grid solar photovoltaic (PV) system installation. In addition, this programme aims to prepare unemployed youth to find employment in the construction industries or to enable them in becomingsuccessful as entrepreneur.

1.2 Course competencies

After completion of training the trainees will be able to:

- Develop professionalism associated with the building electrician trade;
- Maintain Safety;
- Interpret Drawings and Layout Electrical Wiring;
- Maintain Tools & Equipment;
- Install Wiring;
- Perform Installations and Assembling of Electrical Appliance / items;
- Install Electrical Appliances / Items / Solar Panels;
- Perform Distribution of Electrical Supply;
- Perform Preventive and Corrective Maintenance;
- Perform Quality Checks; and
- Maintain Documentation.

1.3 Job opportunities

The pass out of this course would be able to:

- Work in small & big construction units as building electrician
- Work as building electrician in an electrical outfit / company / organization
- Work as building electrician with construction contractor
- Be self employed by having his own electrical / wiring workshop

1.4 Trainee entry level

Individuals who wish to enter this course of study have to comply against the following criteria:

- Grade 8 (Middle) or equivalent;
- Comfort level of English language and mathematics;
- Satisfactory completion of appropriate admission assessment test.

1.5 Minimum qualification of trainer

Trainers who wish to offer this programme should meet one of the following requirements:

- B.Sc. Eng and 2 years of relevant work experience; or
- B-Tech and 3 years of relevant work experience; or
- Diploma Associate Engineer (DAE) and 5 years relevant work experience; or
- Certificate as Building Electrician with 8 years relevant work experience

Trainers offering this programme must be computer literate and be conversant with the delivery of competency-based education and training (CBET). All legislative requirements applicable to carry out training and assessment, if any, must be complied with.

1.6 Teaching strategies in a competency-based environment

Training in a competency-based environment differs from the traditional method of training delivery. It is based on defined competency standards, which are industry oriented.

The traditional role of a trainer changes and shifts towards the facilitation of training. A facilitator in CBET encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the workshop, some writing, some not even in the classroom or workshop but in another part of the building using specialist equipment, working on computers doing research on the Internet or the library. As trainees learn at different pace they might well be at different stages in their learning, thus learning must be tailored to suit individual needs.

The following facilitation methods (teaching strategies) are generally employed in CBET programmes:

- **Direct Instruction Method:** This might beeffective when introducing a new topic to a larger group of trainees in a relative short amount of time. In most cases this method relies on one-way communication, hence there are limited opportunities to get feedback on the trainee's understanding.

- **Discussion Method:** This allows trainees to actively participate in sharing knowledge and ideas. It will help the trainer to determine whether trainees understand the content of the topic. On the other hand, there is a possibility of straying off topic under discussion and some trainees dominating others on their views.

- **Small Group Method:** Pairing trainees to help and learn from each other often results in faster knowledge/skill transfer than with the whole class. The physical arrangement of the classroom/workshop and individual assessment may be challenging. Analogy method should be in corporate.

- **Problem Solving Method:** This is avery popular teaching strategy for CBET. Trainees are challenged and are usually highly motivated when they gain new knowledge and skills by solving problems (Contingency skills). Trainees develop critical thinking skills and the ability to adapt to new learning situations (Transfer skills). It might be time consuming and because trainees sometimes work individually, they may not learn all the things that they are expected to learn.

- **Research Method:** This is used for workshops and laboratory tasks, field experiments, and case studies. It encourages trainees to investigate and find answers for themselves and to critically evaluate information. It however requires a lot of time and careful planning of research projects for the trainee.

1.7 Medium of instructions

- Urdu, local languages and/or English

1.8 Sequence and delivery of the modules

The curriculum for Building Electrician (Assistant) – NVQF level 2, consists of six (6) modules. The delivery of the modules (sequence) is suggested as follows:

Module 1: Electrical Theory
Module 2: Maintenance Installation and Assembling
Module 3: Maintenance
Module 4: Testing and troubleshooting
Module 5: Off-grid solar PV system 1
Module 6: Continuing Professional Development

Learning units within these modules can be delivered interchangeably as stand-alone modules or in an integrated approach.

1.9 Duration of the course

The proposed curriculum is composed of 6 modules, which will be delivered over 896 hours i.e. six (6) months.
The distribution of training hours is as follows:

a) Total Training hours = 896 Hours
b) Theory = 226 Hours (25%)
c) Practical = 670 Hours (75%)

2. Overview about the programme – Curriculum for Building Electrician (Assistant) – NVQF Level 2:

Module Title	Learning Units	Theory[1] Days/hours	Workplace[2] Days/hours	Timeframe of modules
Module 1: Electrical Theory	**LU-1:** Describe basic electrical concepts **LU-2:** Identify hazards associated with electricity **LU-3:** Describe sources of electricity generation **LU-4:** Calculate electrical variables **LU-5:** Perform measurements in electrical circuits **LU-6:** Demonstrate knowledge of electric power **LU-7:** Describe resistive, inductive and capacitive loads **LU-8:** Describe basic magnetic principles	**82**	**46**	**128**
Module 2: Maintenance	**LU-1:** Plan and prepare for work **LU-2:** Use tools and equipment **LU-3:** Inspect and troubleshoot system **LU-4:** Conduct preventive and corrective maintenance	**48**	**290**	**338**

[1]Learning hours in training provider premises
[2]Training workshop, laboratory and on-the-job workplace

Module 3: Installation and Assembling	**LU-1:** Plan and prepare for work **LU-2:** Assemble and Install the products **LU-3:** Test for operation	**35**	**190**	**225**
Module 4: Testing and troubleshooting	**LU-1:** Demonstrate diagnostic procedure **LU-2:** Remove Fault	**22**	**110**	**132**
Module 5: Off-grid solar PV system 1	**LU-1:** Describe the economic benefits of PV systems **LU-2:**Outline PV system fundamentals **LU-3:** Describe off-grid PV system components **LU-4:**Maintain off-grid PV systems and components	**24**	**34**	**58**
Module 6: Continuing Professional Development	**LU-1:** Identify professional development needs **LU-2:** Develop professional knowledge, skills and attitudes **LU-3:** Maintain professional proficiency	**15**	**0**	**15**

3. Building Electrician(Assistant) – Curriculum Contents

Module 1:	**Electrical Theory**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Describe basic electrical concepts • Identify hazards associated with electricity • Describe sources of electricity generation • Calculate electrical variables • Perform measurements in electrical circuits • Demonstrate knowledge of electric power • Describe resistive, inductive and capacitive loads • Describe basic magnetic principles				
Duration:	**Total: 128 hours**	**Theory: 82 hours**		**Practice: 46 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Describe basic electrical concepts**	1.1 Demonstrate knowledge of electron theory	• Definition of matter • Different states of matter with examples • Definition of atom, molecule and element • Atomic structure and shells • Description of proton, electron and neutron • Definition of valence and free electrons • Properties of positive and negative charge • Definition of electricity	**Total** 35Hrs **Theory** 25Hrs **Practical** 10 Hrs	**Non Consumable** • Oscilloscope • Digital clamp meter • Generator • Oscilloscope **Consumable** • Analogue meter • Analogue voltmeter • Animation of atomic model • Animation of states of matter	**Theory** Classroom **Practical** Lab Workshop

	1.2 Describe current flow	• Conventional current and electron flow theory • Static and dynamic charge		• Atomic model • Balloon • Batteries • Clamp meter • Conductor • Digital multi meter • Electric fan • Electric heater • Permanent and temporary magnets • Watt meter • VAR meter • Power factor meter • Coils	
	1.3 Define conductor, semi-conductor and insulator	• Properties of conductors, insulators and semiconductors • Types of diodes, e.g. - Photodiode - Reversing diode - Blocking diode			
	1.4 Apply Ohm's law for DC circuits	• Definition • Laws of resistance • Relation between current (I), voltage (V) and resistance (R)			
	1.5 Describe factors affecting resistance of conductors	• Definition of resistivity • Resistivity of materials • Factors affecting resistance of conductors • Calculating resistance of a conductor with regard to cross sectional area, length, resistivity and operating temperature			

LU-2: **Identify hazards associated with electricity**	2.1 Describe electricity hazards	• Common electricity hazards - Insulation breaks of cable - Guarding or identification of live parts - Grounding - Electric spark due to increased load - Lake of protection equipment uses - Unawareness	**Total** 08Hrs **Theory** 05Hrs **Practical** 03Hrs		**Theory** Classroom **Practical** Lab Workshop
	2.2 Apply the protection procedures for electric shock	• De energizing electric equipment before inspection or repair • Maintaining electric tools • Working near energized lines • Using protective equipment			
	2.3 Identify safety signs and symbols associated with electricity hazards	• Different safety signs and symbols			

LU-3: **Describe sources of electricity generation**	3.1 Identify sources of electricity generation	• Sources of electricity generation - Static electricity - Electromagnetic induction - Electrochemistry - Photovoltaic effect - Thermoelectric effect - Piezoelectric effect - Nuclear transformation	**Total** 15Hrs **Theory** 10 Hrs **Practical** 05Hrs		**Theory** Classroom **Practical** Lab Workshop
	3.2 Nature of electricity (AC or DC) produced by different sources	• Definition of AC and DC electricity • Varying/sinusoidal nature of current and voltage in AC • Non-varying/uniform nature of current and voltage in DC • Importance of polarity in DC circuits			

LU-4: **Calculate electrical variables**	4.1 Demonstrate knowledge of series-, parallel-, and series/parallel electrical circuits	• Circuit layout - Series - Parallel - Series/Parallel • Circuit characteristics - Voltage - Current - Resistance • Fault finding procedures	**Total** 15Hrs **Theory** 10 Hrs **Practical** 05Hrs		**Theory** Classroom **Practical** Lab Workshop
	4.2 Calculate electrical quantities in DC circuits based on Ohm's Law	• Ohm's law wheel - Calculating voltage - Calculating current - Calculating resistance - Calculating power			
	4.3 Calculate electrical quantities in AC circuits based on Ohm's law	• Ohms' Law for AC circuits • Ohms' Law for DC circuits			

LU-5: **Perform measurements in electrical circuits**	5.1 Identify digital and analogue instruments	• Definition and examples of analogue display instruments • Function of digital clamp meter	**Total** 20Hrs **Theory** 08Hrs **Practical** 12Hrs		
	5.2 Measure current and voltage in DC circuit	• Measuring current and voltage in DC circuit • Defining electrical parameters, such as $V_{OC,}$ $V_{max,}$ I_{SC}			
	5.3 Measure frequency of grid electricity	• Functioning of oscilloscope • Measuring frequency of grid electricity using oscilloscope			
	5.4 Measure real and apparent power	• Definition of real, apparent and reactive power • Relationship between real, apparent and reactive power • Units of real/active, apparent and reactive power • Measuring real and apparent power			
	5.5 Measure voltage and frequency of single and three phase grid electricity	• Measuring single phase voltage of grid electricity • Measuring three phase voltage of grid electricity • Measuring frequency of grid electricity			

LU-6: **Demonstrate knowledge of electric power**	6.1 Describe the different ratio for real power, apparent power and reactive power	• Power triangle • Pythagoras theorem • Calculation of angle	**Total** 15Hrs **Theory** 10 Hrs **Practical** 05Hrs		
	6.2 Define the terms KVA, KVAR and KW	• Definition of KVA, KVAR and KW			
	6.3 Measure power factor of grid electricity	• Calculate value of reactive power • Definition of power factor • Measuring power factor of main AC line			
	6.4 State the advantages and disadvantages of low power factor and high power factor	• KVA rating • Per unit cost • Power loss • High current • Increases expenses			
	6.5 Explain the causes of low power factor and techniques to improve it	• Causes of low power factor • Disadvantages of low power factor • Techniques to improve power factor			

LU-7 **Describe resistive, inductive and**	7.1 Define resistance, capacitance and inductance	• Definition of resistance, capacitance and inductance • Units and symbols	**Total** 08Hrs		

capacitive loads	7.2 Differentiate between resistive, inductive and capacitive loads	• Examples of resistive loads • Examples of inductive loads • Examples of capacitive load	**Theory** 06Hrs **Practical** 02Hrs		
	7.3 Explain importance of electrostatic discharge (ESD)	• Definition of ESD • Adverse effects of ESD			
LU-8: **Describe basic magnetic principles**	8.1 Define permanent and temporary magnets	• Definition 'permanent magnets' • Definition 'temporary magnets'	**Total** 12Hrs **Theory** 08Hrs **Practical** 04Hrs		
	8.2 Define the term 'flux'	• Definition 'flux'			
	8.3 Describe magnetic lines of force and list their characteristics	• Magnetic flux • Flux density			
	8.4 Apply the fundamental laws of magnetism	• Fleming's hand rules • Lenz's law			
	8.4 Magnetic properties of different material	• Iron • Steel • Etc			

Module 2:	**Maintenance**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Plan and prepare for work • Use tools and equipment • Inspect and troubleshoot systems • Conduct maintenance				
Duration:	**Total: 338 hours**	**Theory: 48 hours**		**Practice: 290 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Plan and prepare for work**	1.1 Identify and obtain safety and other regulatory requirements for maintenance	• Safety requirements, specifications, Hazard identification	**Total** 23 Hrs **Theory** 03 Hrs **Practical** 20 Hrs	**Non Consumable** • Personal protective equipment • Tools and equipment **Consumable** • Drawing sheets • Lead Pencil • Clip board	**Theory** Classroom **Practical** Lab Workshop Local industry
	1.2 Interpret circuit diagrams	• Drawings and symbols specifications			
	1.3 List the tools are required for plan and prepare of work	• Tools and equipment and calibration thereof			
LU-2: **Use tools and**	2.1 Identify and select tools, equipment and instruments for maintenance	• Purpose of tools, equipment and instruments	**Total** 45Hrs	**Non Consumable** • Electrical tools and machine	**Theory** Classroom

equipment	2.2 Demonstration safe use of tools and equipment	• Use of electrical tools, equipment &instruments	**Theory** 05Hrs **Practical** 40 Hrs	• Oscilloscope • Generator **Consumable** • Handouts • Safety procedures legislation • Hydro meter • Volt meter • Ampere meter • Watt meter • Multi meter • Insulation tape • Battery	**Practical** Lab Workshop Local industry
	2.3 Describe preventive maintenance procedures	• Preventive maintenance - Tools - Equipment - Instruments - Machinery - Facilities			
	2.4 Maintain and / or replace tool insulation	• Types of insulation and reports			
	2.5 Clean and store electrical tool insulation	• Storage requirements			
	2.6 Define the following term	• Electrolyte • Error • Zero error • Calibration			
	2.7 Explain key hazards associated with use of tools and equipment	• Cut on any part of body • Slipping of tools and equipment • Bleeding • First add			
	2.8 Identify the state of charge and types of batteries	• Static • Dynamic • Positive charge • Negative charge • Types of batteries			

	2.9 Maintain electrolyte level	• Role of electrolyte			

	2.10 Describe the procedure for charging batteries	• Charging procedures			
	2.11 Apply the procedure for calibrating measuring instruments	• Types and methods of calibration			
	2.12 Document and interpret calibration	• Types of calibration reports			
	2.13 Calibrate measuring instrument	• Types and methods of calibration • International standards			
	2.14 List the problem that may occur when do calibrating	• Adjusting error • Personal error • Technical error • Equipment error • International standards • Calibrating techniques			
LU-3: **Inspect and troubleshoot systems**	3.1 List the key safety hazards associated with troubleshooting	• Inspection requirements • Troubleshooting requirements	**Total** 85 Hrs **Theory** 15 Hrs **Practical** 70 Hrs	**Non Consumable** • Mega meter • Earth test meter • Synchronize meter • Clamp on meter • Oscilloscope • Pliers	**Theory** Classroom **Practical** Lab Workshop Local industry
	3.2 Describe the procedures for routine check	• Maintenance of electrical instruments and equipment; Types of common faults of wiring; Load balance; Safety precautions			
	3.3 Define the terms	• Troubleshooting • Fault • Loads • Schedule inspection		• Wire cutter • Screw drivers	

	3.4 State the document results	• Test and preventive reports		**Consumable** • Handouts • Safety equipment • Compass • Extension board	
	3.5 States the remedies for un-balance system	• Natural phase fault • Low power factor • Short circuit • Leakage current • Low quality material			
	3.6 Apply the diagnostic procedures for troubleshooting	• Identification of electrical faults by checking shape, size and colour of components and parts; Measurement of electrical parameters; Safety precautions			
	3.7 Identify faulty parts and / or equipment	• Methods of fault identification in electrical components			
	3.8 Analyze system fault	• System operations in an electrical environment			
	3.9 List the tools for required troubleshooting	• Calibration tools • Testing tools • Operational tools • Personal protective tools			

LU-4: **Conduct maintenance**	4.1 Explain the key hazards associated with maintenance	• Identify and obtain safety, hazards and other regulatory requirements	**Total** 95 Hrs	**Non Consumable** • Bench wise	**Theory** Classroom

		for conduct maintenance	**Theory** 15 Hrs **Practical** 80 Hrs	• Battery charger • Pipe wrench • Hand drill machine • Goggles • File set • L Key set • Mega meter • Earth test meter • Synchronize meter • Clamp on meter • Oscilloscope • Hand tool set **Consumable** • Handouts • Safety hazards • Charge controller • Hydrometer • Torch • Wire gauge • Compass	**Practical** Lab Workshop Local industry
	4.2 Describe basic measurements tests	• Measurement and calculation of electrical parameters			
	4.3 Apply minor adjustments and calibrations	• Adjustment techniques for electrical equipment and components; Calibration methods			
	4.4 Replace worn out or damaged parts	• Identification of worn out or damaged parts			
	4.5 Describe the procedures of dismantle faulty parts or components	• Dismantling procedures			
	4.6 Replace or repair faulty parts or components	• Replacing and repairing procedures			
	4.7 Perform commissioning	• Electrical load management • Commissioning procedures			
	4.8 Describe the procedure of Complete work related documents	• Importance of documentation • Customer care procedures & techniques			

	4.9 Explain the purpose of final quality inspection	• Importance of quality handing-over to client		• Extension board • Series board • Phase tester	
	4.10 Clean up and store tools,	• Waste disposal procedures			

	equipment and material	• Care of tools and equipment		• Ampere meter • AVO meter • Soldering iron	
	4.11 Identify the types of maintenance	• Maintenance requirements			
	4.12 Distinguish between preventive and corrective maintenance	• Maintenance tools • Schedule of maintenances • Replace and damage • Minor and major maintenance			
	4.13 State the reason for short circuit	• Low quality cable • Increases load • Temperature increases • Un-awareness			
	4.14 Demonstrate the use of mega meter for a range of tests	• Operational tests • Open circuit, short circuit, continuity test, earth leakage test • Earthing test			

Module 3:	**Installation and Assembling**
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Plan and prepare for work • Assemble and install products

	• Test for operation				
Duration:	**Total: 225 hours**	**Theory: 35 hours**		**Practice: 190 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Plan and prepare for work**	1.1 Identify and interpret safety and other regulatory requirements	• Safety requirements for assembling - Specifications - Hazard identification • Safety requirements for installation - Specifications - Hazard identification	**Total** 75 Hrs **Theory** 15 Hrs **Practical** 60 Hrs	**Non Consumable** • Pliers • Side cutter • Wire striper • Screw drivers • Hacksaw • Bench wise • Earth meter • Earthing rod • Magnetic compass • Clamp meter • Metal frame • Drill machine	**Theory** Classroom **Practical** Lab Workshop Local industry
	1.2 Identify and select the tools and equipment for work	• Types of tools, equipment and material			
	1.3 Interpret circuit diagrams	• Drawings and symbols • Specifications			
	1.4 Explain the purpose of selection and termination of electrical cables	• Types and size of cables • Mounting of cables • Tools for cable works			
	1.5 Arrange earthing	• Earthing requirements			
	1.6 Determine location for solar system	• Factors influencing the efficiency of solar panels • Physical structure		• Metal support • Radiation meter • Solar panel	
	1.7 Demonstrate the setting of	• Summer and winter			

	PV module angles	requirements		• Invertors • Dry batteries **Consumable** • Handouts • Switches • Fuses and circuits breakers • Conduits • Wire and cables • Technical drawing • Insulation tape • Cable striping knife • Soldering iron • Soldering bit • Connectors • Ladder / scaffolding • Diodes and Transistors • Distilled water • Bolts and nuts	
	1.8 List the tools required for installation solar panels	• Radiant meter • Compass • Volt meter • Clamp meter • Hammer drill machine • Nut bolts • Metal frame			

LU-2: **Assemble and install**	2.1 Confirm assembling and installation specifications	• Assembling requirements • Installation requirements	**Total**	**Non Consumable** • Personal protective	**Theory**

products	2.2 Assemble and connect electrical circuit with ports	• Concept of neutral, phase and earth; • Input and output safety precautions	90 Hrs **Theory** 10 Hrs **Practical** 80 Hrs	equipment • Toolsand equipment for cable works • Hand tools and Powered handheld machine tools • Pliers and Side cutter • Wire striper • Screw drivers • Hacksaw • Bench wise • Earth meter • Earthing rod • Magnetic compass • Clamp meter • Metal frame • Drill machine • Metal support • Radiation meter • Solar panel • Invertors • Dry batteries	Classroom **Practical** Lab Workshop Local industry
	2.3 Joint cables and connections	• Types of joints - Simple joint - Married joint - T-joint - Twist joint - Retina joint • Jointing methods - Tin (solder) - Eyelets and tunnel terminals - Cable shoes - Ferrules and shrinking nut - Bolt & screw terminal - Crimped lug • Application of joints			
	2.5 Confirm installation specifications	• Installation requirements			
	2.6 Explain the purpose of position and configure product or appliance	• Importance of correct position and location • Safety precautions			

	2.7 State the reason for sparking	• Loose joint • Static discharge		**Consumable**	

		• Short circuit		• Handouts • Switches • Fuses and circuits breakers • Conduits • Wire and cables • Technical drawing • Insulation tape • Cable striping knife • Soldering iron • Soldering bit • Connectors • Ladder / scaffolding • Diodes and Transistors • Distilled water • Bolts and nuts • Clamps • Cable tie	
	2.8 Demonstrate the procedure forconnecting PV panels and electrical components	• Series and parallel circuit setup • Cable sizing • Forward and reverse diodes			
	2.9 Demonstrate procedure forearthing	• Requirements for properly bonded earthing			

LU-3: **Test for operation**	3.1 Explain the purpose of final quality inspection	• Importance of quality • Handing over to client	**Total** 60 Hrs **Theory** 10 Hrs **Practical** 50 Hrs	**Non Consumable** • Mega meter • Earth test meter • Series board • Phase tester • Oscilloscope **Consumable** • Handouts • Safety Hazards • Template of reports • Volt meter • Ampere meter • Watt meter • Changeover • Relay • Wires • Cable tie • Connectors • Insulation tape	**Theory** Classroom **Practical** Lab Workshop Local industry
	3.2 Demonstrate cleaning up procedures	• Waste disposal procedure • Care of tools & equipment			
	3.3 Test and adjust component and/or parts	• Functional tests and adjustments • Open circuit voltage • Load voltage • Short circuit current • Maximum current load • Change over relay			
	3.4 Demonstrateproduct knowledge to customer	• Product or appliance features • Communication skills			
	3.5 List the reason for quality inspection	• Personal satisfaction • Client satisfaction • Quality of work • Safe for hazards • Quality control			
	3.6 Demonstrate procedures for applying tools and equipment for testing	• Tool identification - Mega - Series board - Phase tester - Series lamp - Earth tester - Armature tester			
	3.7 Complete work related documents	• Customer care procedure and techniques			

Module 4:	**Testing and Troubleshooting**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Demonstrate diagnostic procedures • Remove faults				
Duration:	**Total: 132 hours**	**Theory: 22 hours**		**Practice: 110 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Demonstrate diagnostic procedures**	1.1 Explain the purpose of visual inspection	• Damage identification - cracks - disorders(shape &structure) - broken parts	**Total** 70 Hrs **Theory** 10 Hrs **Practical** 60 Hrs	**Non Consumable** • Oscilloscope • Multimeter • Earthing meter • Mega meter **Consumable** • Safety Hazards • Insulation tape • Serial port • Pliers • Screw drivers • Spanners • Wire cutter&stripper • AC / DC wires • Batteries • Invertors • Hydrometer • Compass • Nuts and bolts	**Theory** Classroom **Practical** Lab Workshop Local industry
	1.2 Demonstrate procedure for implementing testing	• Process of different tests • Electrical parameters			
	1.3 Demonstrate testing proceduresfor solar system	• Test solar cell • Solar plates test • Blocking diode test • Voc,Ise.Vsc			
	1.4 Interpret test results	• Interpretation of drawings andcircuit diagrams			
	1.5 Implement troubleshooting procedures and identify fault	• Troubleshooting • Electrical and electronic parameters			

	1.6 List the problem that may occur when test motor	• Winding insulation fault • Bearing problem • Coupling fault • Rotor stator vibration fault			
	1.7 State the reason for electric shook when touch charged capacitors	• Static charges • Storage of charge • Discharging method			
LU-2: **Remove faults**	2.1 Identify the repair or replace component parts	• Interpretation of drawings and circuit diagrams; product knowledge	**Total** 62 Hrs **Theory** 12 Hrs **Practical** 50 Hrs	**Non Consumable** • Oscilloscope • Multimeter • Earthing meter • Mega meter **Consumable** • Handouts • Safety Hazards • Insulation tape • Serial port • Pliers • Screw drivers • Spanners • Wire cutter • Wire stripers • AC / DC wires • Batteries • Invertors • Hydrometer • Compass • Nuts and bolts	**Theory** Classroom **Practical** Lab Workshop Local industry
	2.2 Carry out operational testing	• Product knowledge; Testing procedures and equipment			
	2.3 Explain the reason for short circuit and leakage current	• Breakage of natural and phase • Short circuits between Phase natural • Insulation break of cable • Temperature effect • Load increases • Low quality cable, material • Un-awareness			
	2.4 Identify the fault finding techniques	• Visual inspection • Technical inspection			

Module 5:	**Off-grid solar PV system 1**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Describe the benefits of PV systems • Outline PV system fundamentals • Describe off-grid PV systems • Maintain off-grid PV systems and components				
Duration:	**Total: 58 hours**	**Theory: 24 hours**		**Practice: 34 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Describe the benefits of PV systems**	1.1 Explain the advantages of solar power	• Power generation and environmental benefits - No greenhouse gases, no harmful emission - No air pollution - No soil damage - No noise • Natural way to produce energy • Easy installation and little maintenance (cost) • Long life timespan	**Total** 08Hrs **Theory** 06Hrs **Practical** 02Hrs	**Consumables** • Stationary • Relevant Book • Steel Scale • Pencil • Eraser • Pointers • Highlighter	**Theory** Classroom **Practical** Lab Workshop
	1.2 Explain the disadvantages of solar power	• Dependant on sun light • DC to AC conversion • May require large areas • Solar panel efficiency			

LU-2: **Outline PV system fundamentals**	2.1 Define the term ‘solar radiation’	• Definition of ‘radiation’ • Light photons	**Total** 08Hrs **Theory** 06Hrs **Practical** 02Hrs	**Consumables** • Stationary • Relevant Book • Steel Scale • Pencil • Eraser • Pointers • Highlighter	**Theory** Classroom **Practical** Lab Workshop
	2.2 Define the term ‘photovoltaic effect’	• Definition of ‘photovoltaic effect’			
	2.3 Describe operation of a basic PV system	• Energy source • Energy conversion • Energy inversion and conditioning • Energy storage • Energy distribution • Energy use • Electric utility			
LU-3: **Describe off-grid PV systems**	3.1 Define the term ‘on-grid’ and ‘off-grid’ PV system	• Definition of ‘on-grid’ • Definition ‘off-grid’ - Advantages - Disadvantages	**Total** 12Hrs **Theory** 06Hrs **Practical** 06Hrs	**Consumables** • Stationary • Relevant Book • Steel Scale • Pencil • Eraser • Pointers • Highlighter	**Theory** Classroom **Practical** Lab Workshop
	3.2 Demonstrate knowledge of off-grid PV systems	• Types of grid • Need for off-grid systems Basic protection AC/DC			
	3.3 Identify PV components and describe their function in an off-grid system	• Solar panels • Charge controller • Battery banks • Inverter • DC cables - Load requirements Mountering structure Combine box			

LU-4: **Maintain off-grid PV systems and components**	4.1 Interpret circuit diagram for off-grid operation	• Drawings • Symbols • Specifications	**Total** 30Hrs **Theory** 6Hrs **Practical** 24Hrs	**Consumables** • Stationary • Relevant Book • Steel Scale • Pencil • Eraser • Pointers • Highlighter	**Theory** Classroom **Practical** Lab Workshop Local industry
	4.2 Outline safety measures associated with PV system maintenance	• Never work alone • Know the system • Condition of tools and test equipment • Personal protective clothing - Safety hat - Eye protection - Dry leather gloves • Be aware when working on heights • Measure first - Conductivity - Voltage - Current			
	4.3 Replace or repair faulty parts or components	• Repair or replacing procedures			

Module 6:	**Apply continuing professional development**				
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: • Identity professional development needs • Develop professional knowledge, skills and attitudes • Maintain professional proficiency				
Duration:	**Total: 15 hours**	**Theory: 15 hours**		**Practice: 0 hours**	
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration (Hours)**	**Materials Required**	**Learning Place**
LU-1: **Identity professional development needs**	1.1 Discuss professional development needs	• Reason s for professional development	**Total** 5 Hrs **Theory** 5 Hrs	**Non Consumable** • Multi media • Projector • Dice • Sound system • White Board **Consumable** • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker	**Theory** Classroom **Practical** Lab Workshop Local industry
	1.2 Identify professional development programmes	• Access to programmes • Career guidance			

LU-2: **Develop professional knowledge, skills and attitudes**	2.1 Participate in training programmes 2.2 Document training outcome	• Outcomes and relevance of training • Report and portfolio writing	**Total** 5 Hrs **Theory** 5 Hrs	**Non Consumable** • Multi media • Projector • Dice • Sound system • White Board **Consumable** • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker	**Theory** Classroom **Practical** Lab Workshop Local industry
LU-3: **Maintain professional proficiency**	3.1 Identify and use self-study sources 3.2 Implement self-study plan	• Research methods • Access to sources • Planning your career	**Total** 5 Hrs **Theory** 5 Hrs	**Non Consumable** • Multi media • Projector • Dice • Sound system • White Board **Consumable** • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker	**Theory** Classroom **Practical** Lab

4. Assessment guidance

Competency-based assessment is the process of gathering evidence to confirm the candidate's ability to perform according to specified outcomes articulated in the competency standard(s).

4.1 Types of assessment

a) Sessional assessment

The goal ofsessional assessment is to monitor student progress in order to provide constant feedback. This feedback can be used by the trainers to improve their teaching and by learners to improve their learning.

More specifically, sessional assessments Help learners to identify their strengths and weaknesses and Help trainers to recognise where learners are struggling and address problems immediately

Examples of sessional assessments include:

- Observations
- Presentations
- Activity sheets
- Project work
- Oral questions

b) Summative (final) assessment

The goal of summative (final) assessment is to evaluate learning progress at the end of a training programme by comparing it against, e.g. set of competency standards.

Examples of summative assessments include:

- Direct observation of work activities
- Final project
- Written questions

4.2 Principles of assessment

When conducting assessment or developing assessment tools, trainers/assessors need to ensure that the following principles of assessment are met:

Validity

- Indicates if the assessment outcome is supported by evidence. The assessment outcome is valid if the assessment methods and materials reflect the critical aspects of evidence required by the competency standards (Competency units, performance criteria, knowledge and understanding).

Reliability

- Indicates the level of consistency and accuracy of the assessment outcomes. The assessment is reliable if the assessment outcome will produce the same result for learners with equal competence at different times or places, regardless of the trainer or assessor conducting the assessment.

Flexibility

- Indicates the opportunity for learners to discuss certain aspects of their assessment with their trainer or assessor, such as scheduling the assessment. All learners should be made aware of the purpose of assessment, the assessment criteria, the methods and tools used, and the context and proposed timing of the assessment well in advance. This can be achieved by drawing up a plan for assessment.

Fair assessment

- Fair assessment does not advantage or disadvantage particular learners because of status, race, beliefs, culture and/or gender. This also means that assessment methods may need to be adjusted for learners with disabilities or cultural differences. An assessment should not place unnecessary demands on learners that may prevent them from demonstrating competence.

4.3 Assessment template – Sessional and Summative assessment

Module Title	Learning Units	Recommended form of assessment	
		Sessional	**Summative**
Module 1: Electrical Theory	**LU-1:** Describe basic electrical concepts **LU-2:** Identify hazards associated with electricity **LU-3:** Describe sources of electricity generation **LU-4:** Calculate electrical variables **LU-5:** Perform measurements in electrical circuits **LU-6:** Demonstrate knowledge of electric power **LU-7:** Describe resistive, inductive and capacitive loads **LU-8:** Describe basic magnetic principles	• Activity sheets • Simulation • Oral and written questions	Integrated assessment: • Project • Demonstration • Role play • Oral and written questions
Module 2: Maintenance	**LU-1:** Plan and prepare for work **LU-2:** Use tools and equipment **LU-3:** Inspect and troubleshoot system **LU-4:** Conduct preventive and corrective maintenance	• Observation • Simulation • Oral and written questions • Demonstration	
Module 3: Installation and Assembling	**LU-1:** Plan and prepare for work **LU-2:** Assemble and Install the products **LU-3:** Test for operation	• Observation • Oral and written questions • Demonstration	
Module 4: Testing and troubleshooting	**LU-1:** Demonstrate diagnostic procedure **LU-2**: Remove Fault	• Observation • Simulation • Oral and written questions • Demonstration	

Module 5: Off-grid solar PV system 1	**LU-1:** Describe the economic benefits of PV systems **LU-2:** Outline PV system fundamentals **LU-3:** Describe off-grid PV system components **LU-4:** Maintain off-grid PV systems and components	• Activity sheets • Simulation • Oral and written questions • Demonstration	
Module 6: Continuing Professional Development	**LU-1:** Identify professional development needs **LU-2**: Develop professional knowledge, skills and attitudes **LU-3**: Maintain professional proficiency	• Activity sheets • Oral and written questions	

5. List of Tools, Machinery & Equipment

Occupational title	Building Electrician (Assistant) – Level 2	
Duration	6 months	
Sr. No.	**Name of Item/ Equipment / Tools**	**Quantity**
1.	Adjustable wrench	**AS PER INDUSTERY CODE OF PRACTAISE**
2.	Amp meter	
3.	AVO meter	
4.	Batteries	
5.	Battery charger	
6.	Bench vice	
7.	Ceiling hole cutter	
8.	Charge controller	
9.	Chisel	
10.	Clamp on meter	
11.	Compass	
12.	Cutter	
13.	Drill machine	
14.	Earth tester meter	
15.	Extension board	

16.	File set	
17.	First Aid box	
18.	Gloves	
19.	Goggles	
20.	Grinder	
21.	Hammer	
22.	Hand drill machine	
23.	Helmet	
24.	Hertz meter	
25.	Hacksaw	
26.	Knife (cable)	
27.	Level	
28.	L-key set	
29.	Lock plier	
30.	Measuring tape	
31.	Mega meter (Analogue& Digital)	
32.	Micrometer	
33.	Multimeter	
34.	Number punch	
35.	Phase sequence meter	
36.	Pipe cutter	

37.	Pipe vice	
38.	Pipe wrench	
39.	Plier set	
40.	Punching tool (Networking /Telephone)	
41.	Ratchet set	
42.	Safety boots	
43.	Scissor	
44.	Screw driver set	
45.	Soldering iron	
46.	Spanner set	
47.	Steel scale	
48.	Steel wire	
49.	Synchronizing meter	
50.	Tachometer	
51.	Tester	
52.	Thimble press	
53.	Tong tester (Clamp-on meter) AC/DC	
54.	Torch	
55.	Verniercaliper	
56.	Volt meter	
57.	Wire gauge	

58.	Wood saw	

6. List of Consumable Supplies

Occupational title	Building Electrician (Assistant) – Level 2		
Duration	**6 months**		
Sr. No.	**Name of Item/ Equipment / Tools**	**Range**	**Quantity**
1.	Flex wire	40/0.076 blue	200m
2.	Flex wire	40/0.076 yellow	200m
3.	Two core twist wire cable	40/0.076	100m
4.	Single way switch	5Amp	24
5.	Tow way switch	5Amp	24
6.	Two pole main switch	10 Amp	24
7.	Two pin socket	5 Amp	24
8.	Lamp holder	Piano Type	24
9.	Lamp holder	Round Type	24
10.	Cable 3/0.029		2 Roll
11.	Cable 7/0.029		1 Roll
12.	Bulb	100W	24
13.	Bulb	200W	24
14.	PVC pipe	"1/2x10Ft	6
15.	Junction Box	4Way , 2 Way	24
16.	Celling Rose	10 Amp	24
17.	Iron Screw	3/16x3/8,3/16x2	2 pack
18.	Wooden Screw	"1,"3/4	2 pack

19.	Wooden Screw	1x1/2,"2	2 pack
20.	Plug show	10Amp	12
21.	Tube Rod	40W	6
22.	Tube starter	220V	12
23.	Timer watching machine	220V	6
24.	Selector switch	220V	6
25.	Indicator	220V	12
26.	Insulation Tap	Neeto	24
27.	Fan Capacitor	(3.5uf)	6
28.	Motor Capacitor	(80/110uf)	6
29.	Connecter	(15A)	12
30.	Element	750W	12
31.	Fiber Washes	7/16 inch	2 pack
32.	Iron Screw difference size	1/2, 3/4, 1", 1.5"	4 pack
33.	Soldering Wire	60/40	6
34.	Paste for soldering	local	6 pack
35.	LED		120
36.	Diode		120
37.	Carbon Resistor		150
38.	Resister 5 Watt		30
39.	Capacitor	16 Volt 1000uf	30
40.	Transistor	NPN, PNP	60
41.	Photo Diode		15

42.	Rod& stator Holder		10 each
43.	Hydro meter		4
44.	Compass		5
45.	Energy saver	24 W	12
46.	Distilled water	Different Size	As per requirements
47.	Sulphuric acid H2so4	Different Size	As per requirements
48.	Batteries	Different Size	As per requirements
49.	DC cables	Different Size	1 coils each
50.	Ravole bolt	Different Size	As per requirements
51.	DC motors	30 watt /50 watt	As per requirements
52.	DC lights	Different Size	As per requirements
53.	DC fans	Different Size	As per requirements
54.	Fuse	Different Size	As per requirements
55.	Butterfly bolts and nuts	Different Size	As per requirements
56.	Expansion bolts	Different Size	As per requirements
57.	Hack saw	Medium	1 dozen

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