Co-funded by the European Union

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Norwegian Embassy
Islamabad

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

NAVTTC

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Published by
National Vocational and Technical Training Commission
Government of Pakistan

Headquarter
Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan
www.navttc.org

Responsible
Director General Skills Standard and Curricula, National Vocational and Technical Training Commission
National Deputy Head, TVET Sector Support Programme, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Layout & design
SAP Communications

Photo Credits
TVET Sector Support Programme

This document has been produced with the technical assistance of the TVET Sector Support Programme, which is funded by the European Union, the Federal Republic of Germany and the Royal Norwegian Embassy and has been commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in close collaboration with the National Vocational and Technical Training Commission (NAVTTC) as well as provincial Technical Education and Vocational Training Authorities (TEVTAs), Punjab Vocational Training Council (PVTC), Qualification Awarding Bodies (QABs)s and private sector organizations.

Document Version
January, 2020
Islamabad, Pakistan

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Table of Contents

1. Introduction

Competence-based training helps to bridge the gap between what is taught in training and what tasks will be performed on the job. Training trainees to perform actual job functions helps to ensure that future front-line workers have the skills, knowledge and abilities required to perform their jobs properly, safely and effectively. In addition to competence-based training, assessment based on the performance of actual work competencies helps to ensure that:

- trainees are performing their work tasks as safely as possible
- performance gaps are recognized prior to serious incidents
- training can be implemented to improve competence.

There are significant benefits to competence-based training:

1.1. Cost effectiveness

Since training activities and assessments in a competence-based approach are goal-oriented, trainers focus on clearly defined areas of skills, knowledge and understanding that their own industry has defined in the competence standards. At the same time, trainees are more motivated to learn when they realize the benefits of improved performance.

1.2. Efficiency

The transfer gap between the training environment and working on the job is reduced substantially in a competence-based approach. This is because training and assessment are relevant to what needs to be done on the job. As a result, it takes less time for trainees to become competent in the required areas. This, in turn, contributes to improved efficiency where training and assessment are concerned.

1.3. Increased productivity

When trainees become competent in the competence standards that their own industry has defined, when they know what the performance expectations are and receive recognition for their abilities through successful assessments, they are likely to be more motivated and experience higher job satisfaction. The result is improved productivity for organizations. The communication and constructive feedback between future employers and employees will improve as a result of a competence-based approach, which can also increase productivity.

1.4. Reduced risk

Using a competence-based approach to training, development, and assessment, employers are able to create project teams of people with complementary skills. A trainee's record of the skills, knowledge and understanding relating to the competence standards they have achieved can be used by a future employer to identify and provide further relevant training and assessment for new skills areas. Competence standards can shape employee development and promotional paths within an organization and give employees the opportunity to learn more competencies beyond their roles. It can also provide organizations with greater ability to scale and flex as needed, thereby reducing the risk they face.

1.5. Increased customer satisfaction

Employees who have been trained and assessed using a competence-based approach are, by the definition of the relevant competence standards, able to perform the required tasks associated with a job. The knock-on effect is that, in service-related industries, they are able to provide high service levels, thereby increasing customer satisfaction. In production or manufacturing industries, they are able to work closely to industry standards in a more effective and efficient way.

2. Lesson plans

This manual provides a series of lesson plans that will guide delivery of each module for the Solar PV Technician Level 4 qualification. It is important for trainers to be flexible and be ready to adapt lesson plans to suit the context of the subject and the needs of their trainees.

Good teachers acknowledge that CBT means each and every trainee in the class learns at a different speed. The good teacher is prepared to throw aside the day's lesson plan and do something different (and unplanned) for the class even if it means 'writing' lesson plan for each trainee to match their learning pace for that day or week.

Learning by doing is different from learning theory and then applying it. To learn to do something, trainees need someone looking over their shoulder saying 'it's not quite like that, it's like this', 'you do it like this because …', or even 'tell me why you chose to do it like this?'.

In this way, trainees learn that theoretical knowledge is meaningless if it is not seen in the context of what they are doing. In other words, if a trainee doesn't know why they do something, they will not do it competently (skills underpinned by knowledge = competent performer).

This is how a *Solar PV* acquires a practical grasp of the standards expected. It's not by learning it in theory, but because those standards are acquired through correction by people who show what the standards are, and correct the trainee where they do not meet those standards, and where they repeat it correction until they have internalized those standards.

3. Demonstration of skill

Demonstration or modeling a skill is a powerful tool, which is used, in vocational training. The instructions for trainers for demonstration are as under:

a) Read the procedure mentioned in the Trainer Guide for the relevant Learning Unit before demonstration.
b) Arrange all tools, equipment and consumable material, which are required for demonstration of a skill.
c) Practice the skill before demonstration to trainees, if possible.
d) Introduce the skill to trainees clearly at the commencement of demonstration.
e) Explain how the skill relates to the skill(s) already acquired and describe the expected results or show the objects to trainees.
f) Carry out demonstration in a way that can be seen by all trainees.
g) Use the same tools and materials that the learner will be using.
h) Go through EACH of the steps involved in performing the skill.
i) Go SLOWLY - describe each step as it is completed.
j) Encourage the learners to move around and watch what you are doing from a number of different angles.
k) Identify critical or complex steps, or steps that involve safety precautions to be followed.

l) Explain theoretical knowledge where applicable and ask questions to trainees to test their understanding.
m) Try to involve the learners: Ask them questions about why they think the process may work that way.
n) Repeat critical steps in demonstration, if required.
o) Summarize the demonstration by asking questions to trainees.

Involvement in the process (actively seeing) is important at this stage. When you work on getting involved, getting people to participate, you make them a part of what is happening. Questions for clarification or explanation are important throughout the demonstration. It is up to the learners to ask questions about things they do not understand, but it is also important for trainers to seek out and elicit questions from learners. A trainer may need to do repeated demonstrations of difficult or complex skills.

4. Overview of the program

Course: *Solar PV Level 4*	**Total Course Duration:** 700 Hours

Course Overview:

Solar energy has been making headlines across the world for the last few years. The global installed capacity of solar photovoltaic (PV), also termed solar cells, has grown from 5GW to more than 400GW. This phenomenal success owes to wide ranging factors; most importantly, conducive policies, technological advancements and economy of scale. Solar PV system is now becoming financially competitive with conventional forms of power generation. Dubai, for example, is currently developing an 800MW through solar PV project with a power purchase agreement signed at less than three US cents per kW hour.

Solar radiation, or level of sunshine, is the resource or fuel for solar energy systems. Accurate measurement and analysis of this resource are fundamental to achieve the anticipated performance. However, there are other important parameters that also need to be taken into account to predict and evaluate a system's performance and this is often where mistakes are made.

The solar industry of Pakistan has nearly doubled in size every year for the past five years, and this trend is expected to continue in future, so there are opportunities for how to become a Solar PV Technician.

Solar PV System Technician determines the design of the array and performs the installations. The process to become a Solar PV System Technician mostly depends on where an individual want to install residential solar systems. Internationally becoming a solar energy professional sometimes requires a license specific to solar PV instalment. Pakistan regulates its own solar installation and safety processes, it might be different from other world rules and regulations, hence required no license but a certificate in this qualification can provide ample of employment opportunities.

The qualification of Building Electrician – Solar PV System Technician is developed based on solar energy sector's demand on the pattern of competency based training under national vocational qualification framework (NVQF). It carries a learning volume of 1000 hours i.e. 6 hours per day and five days a week means 33.4 weeks which is almost 8 months and four months is recommended as internship.

Solar PV System Technician plays a vital role in the installation and maintenance of Solar PV System and Electrical appliances. The increased use of solar energy has maximized the demand of Solar PV Technician 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. The pass out of this course would be able to:

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

Module Title and Aim	Learning Units	Theory hours	Workplace hours	Timeframe of Modules
Module 1: **Conduct site assessment for Solar PV system installation**	**LU-1: Carryout load assessment.** **LU-2: Perform shadow analysis.** **LU-3: Estimate wiring requirements.** **LU-4: Identify the south direction for mounting structure.**	**18**	**32**	**50 hrs**
Module 2: **Develop basic Solar PV system design**	**LU-1: Calculate load for solar PV system design.** **LU-2: Assess working schedule of load.** **LU-3: Select Panels.** **LU-4: Determine backup time.** **LU-5: Draw basic design of solar PV System.**	**20**	**70**	**90 hrs**
Module 3: **Interpret job document**	**LU-1: Prepare checklist for job.** **LU-2: Interpret schematic diagram.** **LU-3: Record the data.** **LU-4: Prepare log sheet for general maintenance.**	**18**	**32**	**50 hrs**
Module 4: **Install Solar PV System**	**LU-1: Arrange required tools and equipment.** **LU-2: Perform PV test.** **LU-3: Erect the mounting structure.** **LU-4: Fix PV modules as per circuit design.** **LU-5: Install Battery Bank.** **LU-6: Install inverter/charge controller / variable frequency drive (VFD).** **LU-7: Install Solar PV Pumps.** **LU-8: Connect the PV modules as per circuit design.**	**28**	**72**	**100 hrs**
Module 5: **Perform Solar PV System Wiring**	**LU-1: Interpret wiring diagram.** **LU-2: Connect the PV modules as per circuit diagram.** **LU-3: Lay Cables.** **LU-4: Perform wiring test.**	**20**	**60**	**80 hrs**

	LU-5: Carry out battery test. **LU-6: Interconnect the PV system.** **LU-7: Configure the inverter / charge controller**			
Module 6: **Troubleshoot Solar PV System**	**LU-1: Diagnose the fault.** **LU-2: Identify solution of the faults.** **LU-3: Rectify the faults.** **LU-4: Carryout post rectification function test.** **LU-5: Perform wiring tests.**	**16**	**54**	**70 hrs**
Module 7: **Maintain Solar PV system**	**LU-1: Prepare check list for maintenance.** **LU-2: Follow routine maintenance log sheet.** **LU-3: Maintain Solar PV modules.** **LU-4: Maintain inverter/Charge. controller/Protection circuits.** **LU-5: Maintain battery bank.** **LU-6: Perform post verification function of the system.**	**13**	**87**	**100 hrs**
Module 8: **Adopt Safety Precautions**	**LU-1: Ensure Personal safety.** **LU-2: Ensure workplace safety.** **LU-3: Ensure safety of tools and equipment.**	**06**	**54**	**60 hrs**
Module 9: **Develop basic Entrepreneurial skills**	**LU-1: Develop basic computer operating skills.** **LU-2: Develop basic communication skills.** **LU-3: Develop basic marketing skills.** **LU-4: Identify needs of the market.** **LU-5: Follow Environmental, Health and Safety standards.**	**22**	**78**	**100 hrs**
TOTAL		**161**	**539**	**700**

4.1. Lesson Plan

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-1

MODULE 1: CONDUCT SITE ASSESSMENT FOR SOLAR PV SYSTEM INSTALLATION			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Carryout load assessment**	Deliver an illustrated presentation on load assessment. Ensure that you address the importance of the following points: • Types of Load. • Specification of various Loads. • Types of measuring instruments. • Working principle of measuring instruments. • Measure running load Display a slide or flip chart with a key questions relating to different loads of an entire system. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to load calculation. Learners must be able to practice and develop their knowledge and skills relating to load and appliances in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 1: CONDUCT SITE ASSESSMENT FOR SOLAR PV SYSTEM INSTALLATION			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Perform shadow analysis.**	Deliver an illustrated presentation on tools used for shadow analysis. Ensure that you address the importance of the following points: • Conduct physical visit of the site • Identify path of the shadow • Use shadow detector • Enquire about future developmental prospects Prepare either: • A flip chart / A PowerPoint slide / A handout Showing the key topics about shadow analysis. Go through all the key topics briefly and then allocate **one key topic** to each group. Learners need to work in their small groups discussing the key topic that has been allocated to their group. Each group should use a sheet of flip chart paper to record **three main points** from their discussions that relate to **their key topic**. After the discussion, begin the feedback session. Ask one group to come to the front of the class with their flipchart. Put up the flipchart where it can be easily seen by other learners. Ask the group to share the main points they have recorded regarding shadow analysis. Discuss these main points briefly with the whole group. Learners should make additional notes **on the flip chart** to record additional points their group had not identified. Then ask the next group to share their flipchart showing the main points they have recorded for the next key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Photograph or scan all the flipcharts and use these to create a handout to distribute to all learners. Learners must be able to practice and develop their knowledge and skills relating to hour calculation in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 1: CONDUCT SITE ASSESSMENT FOR SOLAR PV SYSTEM INSTALLATION			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Estimate wiring requirements**	Brainstorm about the current and its relation with wire. Teach how currents flows in the wire. Use ideas from the brainstorm to explain the following key points • Observe existing condition of wiring (If needed) • Workout length of the wire • Select appropriate size of the wire • Select appropriate type of the wire • Figure out required safety and control devices Display a slide or flip chart with a key question relating to wires and its diameter. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to wiring system. Learners must be able to practice and develop their knowledge and skills relating to wires in an appropriate practical manner. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 1: CONDUCT SITE ASSESSMENT FOR SOLAR PV SYSTEM INSTALLATION			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Identify the south direction for mounting structure**	Discuss the importance of orientation of panels in the installation. Use real examples to support the discussion and ensure the discussion considers: • Observe the location • Point out south direction by using compass Prepare either: • A flip chart • A PowerPoint slides • A handout Showing key topics regarding the facing of solar panels. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for panel direction. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to direction of the panel in appropriate practical demonstrations. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-2

MODULE 2: DEVELOP BASIC SOLAR PV SYSTEM DESIGN			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Calculate load for solar** **PV system design**	Begin this session with an illustrated presentation on calculating the load of the system. Ensure that the presentation addresses the following points, including demonstrations of equipment for arranging tools and equipment where appropriate: • Enlist the No. of appliances • Measure the PV system load • Calculate the PV system load • Record the PV system load Display a flip chart showing the following key question related to calculation of the total load which can either be inductive, capacitive or resistive. It can also be the combination of all the loads. Asking questions on how to ensure the calculated load is right. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. At the end of the activity, ask the learners to return the paper to the original writer. Allow learners a few moments to read over the responses to their writing. Ask learners to work in pairs to reflect on and discuss the responses to the question on the flip chart. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to load calculation in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 2: DEVELOP BASIC SOLAR PV SYSTEM DESIGN			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Assess working schedule of load**	Lead a brainstorm on ways to identify utilization of electricity. Use ideas from the brainstorm to explain the following key points: • Inquire the load duty hours from customer • Determine the peak load hours • Observe peak sun hours Display a slide or flip chart with a key question relating to identifying peak sun hours. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying schedule of the load. Learners must be able to practice and develop their knowledge and skills relating to identifying schedule of the load. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 2: DEVELOP BASIC SOLAR PV SYSTEM DESIGN			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Select Panels**	Lead a discussion about how to identify different panels. Use real examples to support the discussion and ensure the discussion considers: • Select the type of PV panel • Determine the capacity of PV solar panel • Select number of PV solar panel Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying different Solar Panels. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for identifying the panels with greater efficiency and panels which are cost effective. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to identifying of panels. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 2: DEVELOP BASIC SOLAR PV SYSTEM DESIGN			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Determine backup time**	Deliver an illustrated presentation on identifying battery and its backup time calculation. Ensure that you address the importance of the following points: • Estimate the required backup time of load • Estimate the capacity of battery bank • Select the types of batteries for backup Display a slide or flip chart with a key question relating to identifying capabilities of battery. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to batteries, it types and where to use the specific type of battery. Learners must be able to practice and develop their knowledge and skills relating to identifying capabilities of a battery in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 2: DEVELOP BASIC SOLAR PV SYSTEM DESIGN			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU5: **Draw basic design of solar PV System**	Begin this session with an illustrated presentation on identifying basic design of Solar PV system. Ensure that the presentation addresses the following points, including demonstrations of equipment and preparation of designing solar PV system where appropriate: • Workout capacities of devices. • Sketch a diagram as per requirements. • Get the design approve by the client. Arrange a question and answer session to clarify trainee understanding. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard tools for designing solar PV designs. Check that each trainee understands their task. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for designing of Solar PV system. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Trainees need to practice their skills in identifying basic tools and supplies associated with designing of solar PV system in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-3

MODULE 3: INTERPRET JOB DOCUMENT			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Prepare checklist for job**	Deliver an illustrated presentation on job checklists. Ensure that you address the importance of the following points: • Prepare list of material required • Prepare list of tools required • Prepare list of equipment required Display a slide or flip chart with a key questions relating to different checklists for materials, tools and equipment required. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to load calculation. Learners must be able to practice and develop their knowledge and skills relating to lists in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 3: INTERPRET JOB DOCUMENT			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Interpret schematic diagram.**	Deliver an illustrated presentation on different wiring diagrams. Ensure that you address the importance of the following points: • Read schematic diagram of wiring • Read schematic diagram of civil work • Read schematic diagram of mechanical work Prepare either: • A flip chart / A PowerPoint slide / A handout …showing the key topics about different diagrams. Go through all the key topics briefly and then allocate **one key topic** to each group. Learners need to work in their small groups discussing the key topic that has been allocated to their group. Each group should use a sheet of flip chart paper to record **three main points** from their discussions that relate to **their key topic**. After the discussion, begin the feedback session. Ask one group to come to the front of the class with their flipchart. Put up the flipchart where it can be easily seen by other learners. Ask the group to share the main points they have recorded regarding diagrams. Discuss these main points briefly with the whole group. Learners should make additional notes **on the flip chart** to record additional points their group had not identified. Then ask the next group to share their flipchart showing the main points they have recorded for the next key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Photograph or scan all the flipcharts and use these to create a handout to distribute to all learners. Learners must be able to practice and develop their knowledge and skills relating to diagrams of appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 3: INTERPRET JOB DOCUMENT			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Record the data**	Brainstorm about the record keeping. Use ideas from the brainstorm to explain the following key points • Collect the data • Enlist the data • Prepare report Display a slide or flip chart with a key question relating to recording the data. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to data collection, enlisting and generating report. Learners must be able to practice and develop their knowledge and skills relating to data recording in an appropriate practical manner. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 3: INTERPRET JOB DOCUMENT			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Prepare log sheet for general maintenance**	Discuss the importance of general maintenance. Use real examples to support the discussion and ensure the discussion considers: • Prepare schedule of routine maintenance • Identify the activities for conducting routine maintenance • Prepare list of tools for routine maintenance Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics regarding the general maintenance. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for panel direction. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to general maintenance in appropriate practical demonstrations. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-4

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Arrange required tools and equipment**	Begin this session with an illustrated presentation on arranging tools and equipment for the system installation. Ensure that the presentation addresses the following points, including demonstrations of tools and equipment where appropriate: • Collect the required tools and equipment • Check physical status of tools and equipment • Perform transportation of tools and equipment • Manage safe storing of tools and equipment Display a flip chart showing the following key question related to tools and equipment. Asking questions on how to make effective use of tools. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. At the end of the activity, ask the learners to return the paper to the original writer. Allow learners a few moments to read over the responses to their writing. Ask learners to work in pairs to reflect on and discuss the responses to the question on the flip chart. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to arrangement of tools and equipment in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Perform PV test**	Lead a brainstorm on ways to test the Photo Voltaic System. Use ideas from the brainstorm to explain the following key points: • Conduct the short circuit current test • Conduct the open circuit voltage test Display a slide or flip chart with a key question relating to Solar PV testing. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying different test related to Solar PV. Learners must be able to practice and develop their knowledge and skills relating to PV tests. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Erect the mounting structure**	Lead a discussion about how to identify different panels. Use real examples to support the discussion and ensure the discussion considers: • Assemble the structure parts • Fix mounting structure • Adjust angles of the mounting structure Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying different type of frames. If the panels need elevation, use polls. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for identifying mounting structures. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to identifying of structures. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Fix PV modules as per circuit design**	Deliver an illustrated presentation on Installation of PV panels over Mounting structures according to circuit diagram. Ensure that you address the importance of the following points: • Install PV module on the mounting structure • Verify angle of the PV module with the help of • angle finder/meter • Ensure shadow overlapping Display a slide or flip chart with a key question relating to the circuit design. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to batteries, it types and where to use the specific type of battery. Learners must be able to practice and develop their knowledge and skills relating to identifying different circuit designs for varying voltage and current. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU5: **Install Battery Bank**	Begin this session with an illustrated presentation on drawing different designs of Solar PV system. Ensure that the presentation addresses the following points, including demonstrations of equipment and batteries where appropriate: • Arrange batteries with accessories as per requirements • Fix battery bank in the racks • Make parallel series strings for batteries, as per circuit design Arrange a question and answer session to clarify trainee understanding of batteries. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard tools and wires for the connection of batteries. Adopting manufacturer's specification of tools and wires. Check that each trainee understands their task. Trainees need to practice their skills in identifying basic tools and supplies associated with batteries in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU6: **Install inverter / charge Controller / variable frequency drive(VFD)**	Lead a brainstorm on different type of inverters. Use ideas from the brainstorm to explain the following key points: • Arrange inverter and charge controller in variable frequency drive (VFD) • Fix inverter and charge controller in variable frequency drive (VFD) • Ensure fixation as per circuit design Display a slide or flip chart with a key question relating to inverters, charge controllers and VFDs. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying different test related to inverters. Learners must be able to practice and develop their knowledge and skills relating to PV tests. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU7: **Install Solar PV Pumps**	Begin this session with an illustrated presentation on Different AC and DC water pumps. Ensure that the presentation addresses the following points, including demonstrations of tools and equipment where appropriate: • Arrange Solar pumps as per desired capacity • Fix Solar pumps • Ensure fixation of Solar pumps as per circuit design Display a flip chart showing the following key question related to tools and equipment. Asking questions on how to make effective use of tools. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. At the end of the activity, ask the learners to return the paper to the original writer. Allow learners a few moments to read over the responses to their writing. Ask learners to work in pairs to reflect on and discuss the responses to the question on the flip chart. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to arrangement of tools and equipment in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 4: INSTALL SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU8: **Connect the PV modules as per circuit design**	Begin this session with an illustrated presentation on drawing different arrays of solar PV. Ensure that the presentation addresses the following points, including demonstrations of equipment and batteries where appropriate: • Make strings as per circuit design • Make arrays as per circuit diagrams • Connect arrays with junction boxes Arrange a question and answer session to clarify trainee understanding of different array designs for solar PV panels. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard PV connections. Adopting manufacturer's specification of tools and wires. Check that each trainee understands their task. Trainees need to practice their skills in identifying basic tools and supplies associated with circuit design in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-5

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Interpret wiring diagram**	Begin this session with an illustrated presentation on how to interpret diagrams related to wiring. Ensure that the presentation addresses the following points, including demonstrations of techniques related to interpret the wiring diagram where appropriate: • Collect the wiring diagram and layout from job documents • Identify paths and marking for wiring Display a flip chart showing the following key question related to wiring diagrams(symbols). It can also be the combination of all the loads. Asking questions on how to ensure the students get it right. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. At the end of the activity, ask the learners to return the paper to the original writer. Allow learners a few moments to read over the responses to their writing. Ask learners to work in pairs to reflect on and discuss the responses to the question on the flip chart. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to wiring diagrams and symbols in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Connect the PV modules as per circuit diagram**	Lead a brainstorm on ways to identify the series and parallel connections related to solar PV panels. Use ideas from the brainstorm to explain the following key points: • Interconnect the strings to make arrays • Insulate all the arrays as per standard • Combine all the arrays through combiner box Display a slide or flip chart with a key question relating to identifying the connections of PV modules. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying connections described in the diagram. Learners must be able to practice and develop their knowledge and skills relating to identifying connections described in the diagram. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Lay Cables**	Lead a discussion about how to identify the technique of how to lay cables. Use real examples to support the discussion and ensure the discussion considers: • Install conduits for cables • Lay cables through the conduits • Connect the cables to the control and safety boxes Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying different cables and how to connect them with system. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for identifying the cables. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to identifying of cables. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester,

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Perform wiring test**	Deliver an illustrated presentation on identifying the wire tests. Ensure that you address the importance of the following points: • Perform continuity test • Perform polarity test • Perform earth test Display a slide or flip chart with a key question relating to identifying capabilities of current that can flow through the cable. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to wires and cables, it types and where to use the specific type of wires can be used. Learners must be able to practice and develop their knowledge and skills relating to identifying capacity of wire in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Insulation tester

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU5: **Carry out battery test**	Begin this session with an illustrated presentation on identifying basic tools and equipment associated with battery testing. Ensure that the presentation addresses the following points, including demonstrations of equipment for battery testing methods where appropriate: • Perform specific gravity test • Perform internal short circuit test • Perform terminal voltage test • Check terminal for carbon contents • Perform battery bank polarity test Arrange a question and answer session to clarify trainee understanding. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard tools supplies with batteries, checking spare/consumable materials (i.e. distilled water, gravity tester), Adopting manufacturer's specification of tools and equipment. Check that each trainee understands their task. Trainees need to practice their skills in identifying basic tools and supplies associated with battery in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Battery tester and gravity tester

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU6: **Interconnect the PV system**	Begin this session with an illustrated presentation on how to interpret diagrams related to wiring. Ensure that the presentation addresses the following points, including demonstrations of techniques related to interpret the interconnections of PV system where appropriate: • Connect the battery bank to the inverter / charge controller through safety circuits • Connect the PV modules to the inverters /controllers through safety circuits • Connect the inverter with the input A.C source • Connect the load to the inverter through safety circuit Display a flip chart showing the following key question related to connecting the PV panels to the system. It can also be the combination of all the loads. Asking questions on how to ensure the students get it right. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. At the end of the activity, ask the learners to return the paper to the original writer. Allow learners a few moments to read over the responses to their writing. Ask learners to work in pairs to reflect on and discuss the responses to the question on the flip chart. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to connecting the system in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

MODULE 5: PERFORM WIRING OF SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU7: **Configure the inverter / charge controller**	Lead a brainstorm on ways to identify the settings involved in inverter or charge controller. Use ideas from the brainstorm to explain the following key points: • Interpret the inverter manual • Inquire the customers' / site requirements • Set the parameters as per requirement Display a slide or flip chart with a key question relating to identifying the configuration and settings. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying settings for different type of components. Learners must be able to practice and develop their knowledge and skills relating to identifying configurations of inverter or charge controller. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Technician's Manual

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-6

MODULE 6: TROUBLESHOOT SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Diagnose the fault**	Begin this session with an illustrated presentation on identification and diagnostic of faults. Ensure that the presentation addresses the following points, including demonstrations of equipment for arranging tools and equipment where appropriate: • Check invertor for fault code • Verify safety circuits • Check status of wiring • Verify status of battery • Check status of PV Panels • Identify nature of the fault (Hardware or software) • Diagnose the cause of fault • Document the fault Display a flip chart showing the following key question related to faults in the Solar PV system. It can also be the combination of all the loads. Asking questions on how to ensure the diagnosed fault is right. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to diagnosing the fault in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

MODULE 6: TROUBLESHOOT SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Identify solution of the faults**	Lead a brainstorm on ways to identify different solutions to the diagnosed faults. Use ideas from the brainstorm to explain the following key points: • Trace out solution of fault code with the help of manual • Estimate cost of rectification • Report the fault to the concerned persons Display a slide or flip chart with a key question relating to identifying solution to the problems identified. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying problems created. Learners must be able to practice and develop their knowledge and skills relating to identifying faults. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

MODULE 6: TROUBLESHOOT SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Rectify the faults**	Lead a discussion about how to identify and resolve different faults. Use real examples to support the discussion and ensure the discussion considers: • Reset the software for rectification • Arrange the required tools and equipment • Repair faulty component / equipment • Replace faulty component / equipment • Refer irreparable / un-replaceable faults to the concerned lab Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying and rectifying the faults. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for identifying, repair or replace the faults. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to resolving faults. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

MODULE 6: TROUBLESHOOT SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Carryout post rectification function test**	Deliver an illustrated presentation on identifying tests after the rectification. Ensure that you address the importance of the following points: • Re connect the system with the load • Verify function of the system on full load • Document the services as per instructions • Clean and pack the store as per SOP (Standard of Procedure) Display a slide or flip chart with a key question relating to identifying fault rectification tests. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to post solution function tests. Learners must be able to practice and develop their knowledge and skills relating to identifying tests in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

MODULE 6: TROUBLESHOOT SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU5: **Perform wiring tests**	Begin this session with an illustrated presentation on identifying for wiring tests. Ensure that the presentation addresses the following points, including demonstrations of equipment and preparation for wiring test, where appropriate: • Perform continuity test • Perform polarity test • Perform earth test • Rectify the problem Arrange a question and answer session to clarify trainee understanding. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard tools for wire testing. Check that each trainee understands their task. Trainees need to practice their skills in identifying basic tools and supplies associated with wire testing in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Insulation tester

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-7

MODULE 7: MAINTAIN SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Prepare check list for maintenance**	Begin this session with an illustrated presentation on preparing checklist for maintenance. Ensure that the presentation addresses the following points, including demonstrations of equipment for arranging tools and equipment where appropriate: • Prepare list of tools and instruments for maintenance • Prepare list of materials for maintenance • Prepare list of activities for maintenance Display a flip chart showing the following key question related to maintenance. It can also be the combination of all the loads. Asking questions on how to ensure the maintenance checklist is right. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to checklist for maintenence in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Copy and a ball point pen

MODULE 7: MAINTAIN SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Follow routine maintenance log sheet**	Lead a brainstorm on ways to identify routine maintenance procedures and create log sheet. Use ideas from the brainstorm to explain the following key points: • Collect maintenance log sheet • Arrange required tools / instruments for maintenance • Perform activities as per schedule • Place equipment after maintenance as per SOP Display a slide or flip chart with a key question relating to maintenance log sheet. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying problems created. Learners must be able to practice and develop their knowledge and skills relating to identifying routine maintenance procedures. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

MODULE 7: MAINTAIN SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Maintain Solar PV modules**	Lead a discussion about how to maintain Solar PV modules. Use real examples to support the discussion and ensure the discussion considers: • Arrange cleaning materials • Wash the panels as per instructions (Avoid washing during peak sun hours). • Check connections and joints of solar PV modules • Check the physical and mechanical health of modules as per standard • Adjust the seasonal tilt angle Refer irreparable / un-replaceable faults to the concerned lab Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying and rectifying the faults. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for identifying, repair or replace the faults in Solar PV modules. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to maintaining Solar PV modules clean and working. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	IR Thermal imager, Watt tester, Irradiance meter

MODULE 7: MAINTAIN SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Maintain inverter / Charge controller /** **Protection circuits**	Deliver an illustrated presentation on maintenance of inverters and charge controllers. Ensure that you address the importance of the following points: • Arrange servicing equipment • Check the status of cooling fans • Check input output terminals of invertors • Perform servicing with electrical blower • Maintain connection status as per standards Display a slide or flip chart with a key question relating to maintenance of inverter and charge controller. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to maintaining hybrid inverters. Learners must be able to practice and develop their knowledge and skills relating to smooth operation of inverters and charge controllers in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), circuit tester

MODULE 7: MAINTAIN SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU5: **Maintain battery bank**	Begin this session with an illustrated presentation on how to maintain the quality and performance of the battery. Ensure that the presentation addresses the following points, including demonstrations of equipment and preparation for tests of batteries, where appropriate: • Perform continuity test • Perform polarity test • Perform earth test • Rectify the problem Arrange a question and answer session to clarify trainee understanding. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard tools for battery testing. Check that each trainee understands their task. Trainees need to practice their skills in identifying basic tools and supplies associated with battery testing in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Battery tester and gravity tester

MODULE 7: MAINTAIN SOLAR PV SYSTEM			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU6: **Perform post verification** **Function of the system**	Deliver an illustrated presentation on maintenance of PV modules, inverters, charge controllers and overall connections. Ensure that you address the importance of the following points: • Switch on the system • Observe display reading of inverter / charge controller • Perform full load test • Prepare the report of maintenance activities performed Display a slide or flip chart with a key question relating to verifying that the system is running to its optimum level. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to all the test of overall PV system. Learners must be able to practice and develop their knowledge and skills relating to smooth operation of PV system in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Digital Multi meter (DMM), insulation tester, IR thermal imager

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-8

MODULE 8: ADOPT SAFETY PRECAUTIONS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Ensure Personal safety**	Begin this session with an illustrated presentation on ensuring personal protective equipment (PPEs). Ensure that the presentation addresses the following points, including demonstrations of equipment for arranging tools and equipment where appropriate: • Arrange PPEs as per requirements • Wear proper PPE as per nature of job • Store PPEs at appropriate place after use • Ensure availability of first aid box Display a flip chart showing the following key question related to personal safety. It can also be the combination of all the loads. Asking questions on how to ensure the safety is up to the standards. Give each learner a sheet of paper and asked them to write their name at the top. Explain to learners that they will be sharing their work with other learners. Ask learners to write silently for 3-5 minutes answering the question displayed on the flip chart. When learners have completed writing, instruct them to pass their paper to the learner on their left. Each learner will read what their partner has passed to them and write a response. This will also be done silently. After another 2-3 minutes, instruct the learners to pass the paper to their left a second time. Repeat the same procedure, also done in silence. When this activity is concluded, collect the papers and make copies for each learner. Learners must be able to practice and develop their knowledge and skills relating to safety in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Safety Equipment & PPEs

MODULE 8: ADOPT SAFETY PRECAUTIONS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Ensure workplace safety**	Lead a brainstorm on ways to identify and ensure workplace safety. Use ideas from the brainstorm to explain the following key points: • Ensure cleaning of workplace properly • Avoid hazardous (electric / chemical) by adopting safety precautions • Ensure availability of emergency exit • Ensure lighting and ventilation • Ensure availability of Firefighting equipment • Report to the concerned immediately in case of emergency • Ensure safe access to the system Display a slide or flip chart with a key question relating to identifying problems related with the workplace safety. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying hazards in workplace. Learners must be able to practice and develop their knowledge and skills relating to risks and ensuring proper safety which can prevent mishaps. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Safety Equipment & PPEs

MODULE 8: ADOPT SAFETY PRECAUTIONS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Ensure safety of tools and equipment**	Lead a discussion about how to ensure that all the safety and protection equipment is available. Use real examples to support the discussion and ensure the discussion considers: • Ensure insulation of tools and equipment • Store safely tools and equipment • Clean tools on a regular basis as per schedule Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying tools and equipment related to safety. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for ensuring that all the safety and protection equipment is available. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to all the safety and protection equipment. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	Safety Equipment & PPEs

BUILDING ELECTRICIAN SOLAR PV SYSTEM TECHNICIAN

Trainer Guide

National Vocational Certificate Level 4

Version 1 - January 2020

Module-9

MODULE 9: DEVELOP BASIC PROFESSIONAL SKILLS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU1: **Develop basic computer operating skills**	Begin this session with an illustrated presentation on identification and diagnostic of faults. Ensure that the presentation addresses the following points, including demonstrations of equipment for arranging tools and equipment where appropriate: • Perform Microsoft basic commands in MS word a. Open File b. Format a file i. Font (Type/size/bold/Italic) ii. Header Footer iii. Page number iv. Insert pics/table/hyperlink c. Save a File d. Save a folder • Perform basic commands in Microsoft MS Excel a. Open a worksheet b. Sum functions c. If functions d. Basic calculations e. Table and graphs f. Save a worksheet/folder • Prepare Microsoft power point presentation by using basic commands • Perform browsing on the internet as per needs • Perform research online on new trends in the market with the help of internet Display a flip chart showing the following key question related to faults in the Solar PV system. It can also be the combination of all the loads. Asking questions on how to work on computer properly. Learners must be able to practice and develop their knowledge and skills relating to basic computer operating skills in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 9: DEVELOP BASIC PROFESSIONAL SKILLS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU2: **Develop basic communication skills**	Lead a brainstorm on ways to identify basic skills on how to communicate with customer. Use ideas from the brainstorm to explain the following key points: • Negotiate with a client to understand the demand • Plan product supply as per client's requirements • Set price(s) according to client's requirements • Communicate the plan to the client • Take feedback from client on understanding of the • exact job with timeline and cost Display a slide or flip chart with a key question relating to communication skills. **Step 1 – Think** Working on their own, each learner thinks about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner pairs up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to identifying communication skills. Learners must be able to practice and develop their knowledge and skills relating to communication. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 9: DEVELOP BASIC PROFESSIONAL SKILLS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU3: **Develop basic marketing skills**	Lead a discussion about how to develop basic marketing skills. Use real examples to support the discussion and ensure the discussion considers: • Present a design to the client as per requirement • Finalize the business deal • Purchase the equipment/tools and consumables as per agreed design • Adopt correct means of transportation • Select promotional means, according to target needs of clients Refer irreparable / un-replaceable faults to the concerned lab Prepare either: • A flip chart • A PowerPoint slides • A handout …showing key topics for identifying and rectifying the faults. Learners need to work in small groups discussing the key topics. Each group should make notes from their discussions that identify **three main points** that related to **each key topic**. After the discussion, begin the feedback session. Ask one group to share the main points they have recorded for the first key topic for learning marketing. Discuss these main points briefly with the whole group. Learners should make additional notes to record additional points their group had not identified. Then ask the next group to share the main points they have recorded for the second key topic. Repeat the discussion process. Continue until you have covered all the key topics. End the group discussion activity with a summary. Learners must be able to practice and develop their knowledge and skills relating to marketing. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 9: DEVELOP BASIC PROFESSIONAL SKILLS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU4: **Identify needs of the market.**	Deliver an illustrated presentation on identifying the required equipment in the market. Ensure that you address the importance of the following points: • Analyze upcoming market trends. • Develop Professional network. • Demonstrate behavioral skills. • Develop sound interpersonal skills • Develop new designs. Display a slide or flip chart with a key question relating to identifying needs of the customer and market. **Step 1 – Think** Working on their own, each learner **thinks** about the question and makes notes of their responses or key points which they believe to be important. **Step 2 – Pair** For the next step, each learner **pairs** up with a partner. The two learners exchange their ideas and make further notes to add clarity to their own ideas. **Step 3 – Share** The final step is for you to invite different pairs to share the ideas they have discussed in response to the key question relating to post solution function tests. Learners must be able to practice and develop their knowledge and skills relating to market needs in an appropriate practical setting. Ensure that learners have the opportunity to ask questions to support their understanding.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

MODULE 9: DEVELOP BASIC PROFESSIONAL SKILLS			
Learning Unit	**Suggested Teaching / Learning Activities**	**Delivery Context**	**Media / Tools**
LU5: **Follow Environmental, Health and Safety standard**	Begin this session with an illustrated presentation on following environment friendly materials and equipment. Ensure that the presentation addresses the following points, including demonstrations of on environment safety, where appropriate: • Follow Health and Safety Rules • Ensure environmental safety • Ensure compliance of net metering policy • Ensure workplace safety by following safety standards • Ensure safety while operating wires and electricity. • Store all tools and equipment properly in a safe area. Arrange a question and answer session to clarify trainee understanding. To prepare for practical sessions, divide the trainees in small groups. Provide each group with a task such as Checking standard tools for wire testing. Check that each trainee understands their task. Trainees need to practice their skills in environment, health and safety standards in a real or realistic environment.	Class room with multimedia aid, audio-visual facilities and flip charts Workshop or Workplace	• Presentations. • Videos • Whiteboard • Learning guide • Job card • Tools

Frequently Asked Questions

1. What is Competency Based Training (CBT) and how is it different from currently offered trainings in institutes?	Competency-based training (CBT) is an approach to vocational education and training that places emphasis on what a person can do in the workplace as a result of completing a program of training. Compared to conventional programs, the competency-based training is not primarily content based; it rather focuses on the competence requirement of the envisaged job role. The whole qualification refers to certain industry standard criterion and is modularized in nature rather than being course oriented.
2. What is the passing criterion for CBT certificate?	You shall be required to be declared “Competent” in the summative assessment to attain the certificate.
3. What are the entry requirements for this course?	The entry requirement for this course is 8th Grade or equivalent.
4. How can I progress in my educational career after attaining this certificate?	You shall be eligible to take admission in the National Vocational Certificate Level-3 in Leather Products Development Technician (Pattern Maker). You shall be able to progress further to National Vocational Certificate Level-4 in Heavy Construction Machinery Operator Course; and take admission in a level-5, DAE or equivalent course (if applicable). In certain case, you may be required to attain an equivalence certificate from The Inter Board Committee of Chairmen (IBCC).
5. If I have the experience and skills mentioned in the competency standards, do I still need to attend the course to attain this certificate?	You can opt to take part in the Recognition of Prior Learning (RPL) program by contacting the relevant training institute and getting assessed by providing the required evidences.
6. What is the entry requirement for Recognition of Prior Learning program (RPL)?	There is no general entry requirement. The institute shall assess you, identify your competence gaps and offer you courses to cover the gaps; after which you can take up the final assessment.
7. Is there any age restriction for entry in this course or Recognition of Prior Learning program (RPL)?	There are no age restrictions to enter this course or take up the Recognition of Prior Learning program
8. What is the duration of this course?	The duration of the course work is 1,510 hrs. (11 months)

9. What are the class timings?	The classes are normally offered 25 days a month from 08:00am to 01:30pm. These may vary according to the practices of certain institutes.
10. What is equivalence of this certificate with other qualifications?	As per the national vocational qualification's framework, the level-4 certificate is equivalent to Matriculation. The equivalence certificate can be obtained from The Inter Board Committee of Chairmen (IBCC).
11. What is the importance of this certificate in National and International job market?	This certificate is based on the nationally standardized and notified competency standards by National Vocational and Technical Training Commission (NAVTTC). These standards are also recognized worldwide as all the standards are coded using international methodology and are accessible to the employers worldwide through NAVTTC website.
12. Which jobs can I get after attaining this certificate? Are there job for this certificate in public sector as well?	You shall be able to take up jobs in the local or overseas construction companies in heavy machinery operator job profile.
13. What are possible career progressions in industry after attaining this certificate?	You shall be able to progress up to the level of supervisor after attaining sufficient experience, knowledge and skills during the job. Attaining additional relevant qualifications may aid your career advancement to even higher levels.
14. Is this certificate recognized by any competent authority in Pakistan?	This certificate is based on the nationally standardized and notified competency standards by National Vocational and Technical Training Commission (NAVTTC). The official certificates shall be awarded by the relevant certificate awarding body.
15. Is on-the-job training mandatory for this certificate? If yes, what is the duration of on-the-job training?	On-the-job training is not a requirement for final / summative assessment of this certificate. However, taking up on-the-job training after or during the course work may add your chances to get a job afterwards.
16. How much salary can I get on job after attaining this certificate?	The minimum wages announced by the Government of Pakistan in 2019 are PKR 17,500. This may vary in subsequent years and different regions of the country. Progressive employers may pay more than the mentioned amount. The heavy Machinery Operator normally earns 20,000 to 25,000 in the start.
17. Are there any alternative certificates which I can take up?	There are some short courses offered by some training institutes on this subject. Some institutes may still be offering conventional certificate courses in the field.

18. What is the teaching language of this course?	The leaching language of this course is Urdu and English.
19. Is it possible to switch to other certificate programs during the course?	There are some short courses offered by some training institutes on this subject. Some institutes may still be offering conventional certificate courses in the field.
20. What is the examination / assessment system in this program?	Competency based assessments are organized by training institutes during the course which serve the purpose of assessing the progress and preparedness of each student. Final / summative assessments are organized by the relevant qualification awarding bodies at the end of the certificate program. You shall be required to be declared “Competent” in the summative assessment to attain the certificate.
21. Does this certificate enable me to work as freelancer?	You can start your small business by purchasing your own heavy construction machine and can start earning 50,000 per month. You may need additional skills on entrepreneurship to support your initiative.

Test Yourself (Multiple Choice Questions)

KNOWLEDGE ASSESSMENT TEST

Conduct site assessment for solar PV system

Module:1 Time Allowed: 45 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple-choice questions.

1) The following is indirect method of Solar energy utilization?

a. Wind energy
b. Biomass energy
c. Wave energy
d. None of above

2) What is a load?

a. It is resistance of a circuit
b. It is capacitance of a circuit
c. It is impedance of a circuit
d. None of above

3) The value of Solar Constant is

a. 1347 W/m^2
b. 1357 W/m^2
c. 1367 W/m^2
d. 1500 W/m^2

4) Theoretical efficiency of monocrystalline PV cell is

a. 1%

b. 20%
c. 50%
d. 100%

5) lux meter is use to check the

a. Power
b. Resistance
c. Luminous intensity
d. Current

Instructions to Candidates: You must write short answers to all questions.

Q1. How solar energy is converted into electrical energy?

Answer:

Q2. What is electrical current?

Answer:

Q3. What is meant by electrical voltage?

Answer:

Q4: What are the different type of loads?

Answer:

Q5. What should be the direction of solar PV panels?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:2 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) Load is

a. Only Resistive
b. Only Capacitive
c. Only Inductive
d. None of above

2) What percentage loses are in solar panels?

a. 20%
b. 30%
c. 50%
d. None of above

3) DOD stands for

a. Depth of demand
b. Depth of Discharge
c. Demand of Discharge
d. Demand

4) Theoretical efficiency of monocrystalline PV cell is

a. 1%
b. 20%
c. 50%
d. 100%

5) Volt meter is use to check the

a. Power
b. Resistance
c. Voltage
d. Current

Instructions to Candidates: You must write short answers to all questions.

Q1. How are Peak sun hours calculated?

Answer:

Q2. What are different types of solar PV module?

Answer:

Q3. How to calculate battery backup?

Answer:

Q4: Draw the basic design of 2 solar PV modules connection with PV system.

Answer:

Q5. Which Batteries are best for Solar PV system?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:3 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) Before going how to know which tool is missing?

a. Checklist
b. Toolbox
c. Ask a colleague
d. None of above

2) In a schematic diagram, there are

a. Symbols
b. Generic diagram
c. Real picture of a component
d. None of above

3) How can the data be recorded?

a. Collect data
b. Enlist data
c. Report data
d. All of the above

4) Routine checkup is a form of

a. Corrective maintenance
b. Preventive maintenance
c. Both a and b

d. None of above

5) What is the symbol for wire.

a. Looped line
b. Dotted line
c. Dashed line
d. Continuous line

Instructions to Candidates: You must write short answers to all questions.

Q1. How to make a simple checklist?

Answer:

Q2. Draw a diagram of 2 bulbs and fan controlled by 3 switches and a dimmer.

Answer:

Q3. Make a list of items used in solar PV system?

Answer:

Q4: what are the general maintenance of solar panels?

Answer:

Q5. Make a list of general maintenance of Solar PV system?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:4 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) While doing a job in the field, it is necessary to

a. Ware tool belt
b. Have toolbox
c. Ware PPEs
d. All of the above

2) Which angle is to be taken care of while panels face south direction

a. Azimuthal angle
b. Panel angle
c. Latitude angle
d. Longitude angle

3) Short circuit test is used for

a. Maximum voltage
b. Maximum current
c. Luminous intensity
d. Maximum Power

4) Open circuit test is used for

a. Maximum voltage
b. Maximum current
c. Luminous intensity
d. Maximum Power

5) In submersible pump which is the best option.

a. VFD
b. Inverter
c. Charge controller
d. None of the above

Instructions to Candidates: You must write short answers to all questions.

Q1. What are the tools used for general maintenance?

Answer:

Q2. What is short circuit and open circuit test?

Answer:

Q3. How much current flows when short circuit and open circuit show with equation?

Answer:

Q4: Discuss any 3 types of mounts for Solar panels?

Answer:

Q5. How can we increase the voltage and current of the given batteries?

Answer:

KNOWLEDGE ASSESSMENT TEST

(Perform Solar PV system Wiring)

Module:5 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) In series connection current

a. Increases
b. Decreases
c. Remains same
d. None of above

2) Which test can confirm that wire is broken in the middle?

a. Continuity test
b. Polarity test
c. Earthing test
d. None of above

3) Which test can confirm that the battery cell voltage is low

a. Polarity test
b. Gravity test
c. Continuity test
d. Battery test

4) In a charge controller what should be the first component to be connected?

a. Solar panels
b. Stands

c. Earthing plate
d. Battery

5) In case of open circuit, the current flowing in the circuit is

a. Zero
b. Very low
c. Normal
d. Infinite

Instructions to Candidates: You must write short answers to all questions.

Q1. What are the types of Electrical Wiring?

Answer:

Q2. How to connect 50 panels in such a way to get 100V from 20V?

Answer:

Q3. How to cover the cables from environmental damage?

Answer:

Q4: Briefly write wiring tests.

Answer:

Q5. Please explain five different configurations of hybrid inverter?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:6 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) If there is black mark on the connection, it is because of_____.

a. Short circuit
b. Open circuit
c. Perfect circuit
d. Lose connection

2) Inverter is continuously beeping after 2-5seconds mean _____

a. Battery full
b. Battery low
c. Short circuit
d. Open circuit

3) What is the possible fault if panel is not passing any current

a. By-pass diode is burnt
b. Cell is damaged in the panel
c. Panel is broken
d. Dummy cell in a panel

4) Battery gives low voltage, when connected to the load means

a. Battery is new
b. Inverter configuration is wrong
c. Battery cell is short circuited
d. Battery is fully charged

5) Circuit Breaker is turning off automatically after turning on the inverter

a. The circuit breaker is of high ampere
b. The circuit breaker is working properly
c. The circuit breaker is of low ampere
d. None of the above

Instructions to Candidates: You must write short answers to all questions.

Q1. What are different faults regarding solar PV system?

Answer:

Q2. How to check whether resistor is faulty?

Answer:

Q3. What is troubleshooting?

Answer:

Q4: How to perform earthing test?

Answer:

Q5. What is post verification test?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:7 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) Preventive Maintenance contains

a. Repair
b. Regular checkup
c. Personal Protective Equipment (PPEs)
d. None of above

2) Maintenance checklist include

a. Electrical section
b. Mechanical section
c. Safety section
d. All of the above

3) Solar panels should be washed

a. When panels are hot
b. When panels are cold
c. When panels are dusty
d. When panels are dry

4) Inverter/ charge controller should be repaired

a. Immediately after disconnecting it
b. After 5 minutes
c. After 10 minutes
d. None of above

5) Specific gravity of battery tells

a. Life of the cell
b. Voltage of the cell
c. Shorting of the cell
d. Number of plates in the cell

Instructions to Candidates: You must write short answers to all questions.

Q1. What are tools and instruments for maintenance?

Answer:

Q2. What is routine maintenance log?

Answer:

Q3. How to maintain the solar panels?

Answer:

Q4: What is the maintenance procedure for inverters/Charge controller?

Answer:

Q5. What is the maintenance procedure for battery banks?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:8 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

1) PPE stands for?

a. Protect personnel Equipment
b. Personal Protective Equipment
c. Personal Precaution Equipment
d. None of above

2) What does a risk assessment tell you?

a. How to report accidents
b. The working hours of the organization
c. Where the first aid box is and the first aiders
d. What risks are associated with the job

3) For which actions is the risk of accident the highest?

a. Fashioning steel with an angle grinder
b. Fashioning steel with a file
c. Fashioning steel with a hammer
d. None of above

4) The safety regulations require an employer to provide which of the following?

a. Toilet Facility

b. Hand tools
c. Lunch
d. Personal protective equipment

5) Industrial safety management is that branch of management which is concerned with _____ hazards from the industries.

a. Reducing
b. Controlling
c. Eliminating
d. All of the above

Instructions to Candidates: You must write short answers to all questions.

Q1. What is first Aid Treatment?

Answer:

Q2. What is the safe procedure of separating the victim from electricity shock?

Answer:

Q3. Types of electrical hazards

Answer:

Q4: What is PPEs?

Answer:

Q5. Enlist the Safety precaution during Work?

Answer:

KNOWLEDGE ASSESSMENT TEST

Module:9 Time Allowed: 30 minutes

Candidate Name: _____ Father Name: _____

Instructions to Candidates: You must answer all multiple choice questions.

2) Essential for communication skills are?

a. Listening
b. Confidence
c. Friendliness
d. all of the above

2) Checklist can be made in _____.

a. Excel
b. Word
c. PowerPoint
d. None of above

3) _____ are the form of human needs take as shaped by culture & individual personality.

a. Wants
b. Demands
c. Needs
d. Social needs

4) Communication is a non-stop_____.

a. Plan
b. Process

c. Paper
d. None of above

5) Alt+Ctrl+Del is used for.

a. Task manager
b. Explorer
c. Internet explorer
d. New file

Instructions to Candidates: You must write short answers to all questions.

Q1. What are the shortcut keys for copy, paste, cut, redo and undo?

Answer:

Q2. How to do research online on new trends in the market with the help of internet?

Answer:

Q3. How to negotiate with a client to understand the demand?

Answer:

Q4: What are the basic solar packages for domestic solar PV system?

Answer:

Q5. How to ensure environmental safety?

Answer:

ANSWERS:

Module1:

Q1. d Q2. c Q3.c Q4. b Q5. c

Module2:

Q1. d Q2. b Q3. b Q4. b Q5. c

Module3:

Q1. a Q2. a Q3. d Q4. c Q5. d

Module4:

Q1. d Q2. a Q3. b Q4. a Q5. a

Module5:

Q1. c Q2. a Q3. b Q4. d Q5. a

Module6:

Q1. d Q2. b Q3. a Q4. c Q5. c

Module7:

Q1. a Q2. b Q3. c Q4. b Q5. c

Module8:

Q1. b Q2. d Q3. a Q4. d Q5. a

Module9:

Q1. d Q2. a Q3. d Q4. b Q5. a

National Vocational and Technical Training Commission (NAVTTC)

Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan
+92 51 9044 322
+92 51 9044 322
info@navttc.org
www.navttc.org