Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

PHOTO-VOLTAIC HOME SYSTEM INSTALLATION

RENPV301

Install Photo Voltaic Home System

Competence

RQF Level: 3

Learning Hours 70

Credits: 7

Sector: Energy

Trade: Renewable energy

Module Type: Specific

Curriculum: ENGREN3001- TVET Certificate 3 in Renewable Energy

Issue Date: April 2022

Purpose statement	This module describes the skills, knowledge and attitude required to install basic of home solar PV system, At the end of this module, learners will be able to analyze the site for home solar P.V system installation, install home solar system and design home solar system. Qualified learners deemed competent to this competency may work alone or with others on routine tasks in various places .
Learning to be assumed in place	SHE, Basic of Electricity and electronic, Bench work applied to electricity.

Delivery modality

Training delivery		100%	Assessment		Total 100%
Theoretical content		30%	Formative assessment	30%	50%
Practical work:		70%		70%	
• Group project and presentation	20%				
• Individual project /Work	50%				
		Summative Assessment			50%

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. Design PV solar system	1.1. Total energy demand is properly estimated according to the standards
	1.2. Solar PV system components are correctly sized according to loads
	1.3. Solar PV system components are properly selected based on standards
2. Preform site setting	2.1. Materials, equipment and tools are properly selected according to the work to be done
	2.2. The drawings are properly interpreted as per design
	2.3. The dimensions are precisely taken and correctly marked based on direction of sun direction
	2.4. The materials for structural support are properly prepared according to the drawings
	2.5. The structural support are properly assembled and fixed according to the design
3. Mount solar PV Panels	3.1. Prefabricated supports are carefully mounted according to their types.
	3.2. The solar PV Panels are properly fixed on prefabricated structural support with appropriate bolt and nuts according to the drawing.
	3.3. PV modules are properly interconnected according to the drawing.
	3.4. Distribution board is properly connected to PV Panels based on the drawing.
4. Interconnect the PV system components	4.1. Tools are properly selected according to the work to be done.
	4.2. The PV system components are properly selected according to the size of the PV system

	4.3. The PV system components are properly connected according to polarities indications.
	4.4. The continuity of the wires are properly checked according to the work done
5. Connect protective devices	5.1. Surge Protective Device and circuit breakers are properly installed according to the loads
	5.2. Tools, materials and equipment for earthing are properly selected based on the installation to be earthed
	5.3. Earthing protection is properly done based on national standards

Course content

Learning outcomes	At the end of the module the learner will be able to: 1. Design Solar PV System 2. perform site setting 3. Mount solar PV Panels 4. Interconnect the PV system components 5. Connect protective devices
Learning outcome 1: Design Solar PV System	**Learning hours: 15**

Indicative content

- **Analysing energy demand description**
  - ✓ Electrical appliances types
  - ✓ Appliances wattage ratings
- **Sizing solar PV system components**
  - ✓ Solar PV panels
  - ✓ Battery bank
  - ✓ Inverter
  - ✓ Charge controller
  - ✓ Protective devices
  - ✓ Wires and cables
- **Selecting solar PV system component**
  - ✓ Solar PV panels
  - ✓ battery bank
  - ✓ inverter
  - ✓ charge controller
  - ✓ Protective devices
  - ✓ Wires and cables

Resources required for the learning outcome

Equipment	PV Panel, Charge controller, Inverter, Battery, Grinding machine, Drilling machine
Materials	Bit's kit, Insulator, Cutting wheel, Angle iron, Bolt, Nuts, Drill bits, Cutting wheel
Tools	Screw Driver kit, Pliers Kit, Measurement tape, Spirit Level, Hack saw
Facilitation techniques & learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided

	• Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 2: perform site setting	**Learning hours: 10**
Indicative content	

- **Selection of tools, materials and equipment**
  - ✓ The types of tools
  - ✓ The types of equipment
  - ✓ The types of materials
- **Interpretation of the drawing.**
  - ✓ Symbols
  - ✓ Types of drawing
  - ✓ Scale
- **Measurement and marking the position.**
  - ✓ Measuring tools
  - ✓ Reading dimensions
  - ✓ Marking position
- **Preparation of materials for structure support.**
  - ✓ Types of structure support
  - ✓ Metal Cutting
  - ✓ Drilling holes
  - ✓ Painting
- **Assembling and fixing the structure support**
  - ✓ Keys
  - ✓ Angles
  - ✓ Bolts and nuts

Resources required for the learning outcome	
Equipment	PV Panel , Charge controller, Inverter, Battery, Grinding machine, Drilling machine
Materials	Bit's kit, Insulator, Cutting wheel, Angle iron, Bolt, Nuts, Drill bits, Cutting wheel
Tools	Screw Driver kit, Pliers Kit, Measurement tape, Spirit Level, Hack saw, Electric knife, Chisel, Spring Bend, Cartridge brazing, Spanners Kit, Electrical wire short, Ladder, Notebook / Pen, Flashlight, Plumb wire, Personal Protective Equipment, Scriber , Ball pin Hammer, Cross hammer

Facilitation techniques & learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 3: Mount solar PV Panels	**Learning hours: 25**
Indicative content	

- **Mounting the prefabricated support**
  - ✓ Types of mounting
  - ✓ Advantages / disadvantages of different types
  - ✓ Site selection
- **Fixing the solar PV panels on the structural support**
  - ✓ Essential Tools for Solar Installation
  - ✓ Size of nuts and bolts
  - ✓ Types of fixing and mounting
  - ✓ Site selection
  - ✓ Advantages / disadvantages of different types
- **Interconnection of PV module**
  - ✓ Types of tools
  - ✓ Polarities
  - ✓ loads
  - ✓ Types of connection
- **Connect the distribution board to PV panels based on the drawing.**
  - ✓ Types of distribution board
  - ✓ Types of circuit breakers

- ✓ Select location
- ✓ Ratings of circuit breakers

Resources required for the indicative content	
Equipment	PV Panel, Inverter, Battery, Grinding machine, Drilling machine
Materials	Electric cables, Junction Box, Lamps, Socket plug, Lamp holder, Electrical wires, Earth wire, Mild Steel tube
Tools	Screw Driver kit, Pliers Kit, Measurement tape, Spirit Level, Hack saw, Electric knife, Spanners Kit, Electrical wire short, Ladder, Notebook / Pen
Facilitation techniques & learning activities	• Demonstration and simulation • Individual and group work • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 4: Interconnect the PV system components	**Learning hours: 10**

Indicative content

- **Selection of tools, materials and equipment**
  - ✓ Types of tools
  - ✓ Types of materials
  - ✓ Types of equipment
- **Selection of PV system components**
  - ✓ Types of solar panels
  - ✓ Types of batteries
  - ✓ Types of charge controller
  - ✓ Types of inverter
  - ✓ Types of loads
- **Connection of PV system components**
  - ✓ Types of connection
  - ✓ Position
- **Check the continuity of the wires according to the work done**
  - ✓ Measuring instrument
  - ✓ Calibration

Resources required for the indicative content	
Equipment	PV Panel, Inverter, Battery, Grinding machine, Drilling machine
Materials	Electric cables, Junction Box, Lamps, Socket plug, Lamp holder, Electrical wires, Earth wire, Mild Steel tube
Tools	Screw Driver kit, Pliers Kit, Measurement tape, Spirit Level, Hack saw, Electric knife, Spanners Kit, Electrical wire short, Ladder, Notebook / Pen
Facilitation techniques & learning activities	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Learning outcome 5: Connect Protective Devices	Learning hours: 10

Indicative content

- **Description of protective devices**
  - ✓ Types of surge protective devices
  - ✓ Types of circuit breakers
  - ✓ Ratings of circuit breakers
  - ✓ Importance of circuit breakers
- **Selection of tools, materials and equipment for earthing**
  - ✓ Tools for earthing
  - ✓ Materials for earthing
  - ✓ Equipment for earthing
- **Installation of earthing protection**
  - ✓ Earthing Types
  - ✓ Earthing procedures
  - ✓ Earthing advantages
  - ✓ Methods of earthing
  - ✓ Earth resistance value
- **Fitting the Earth rods and wires**
  - ✓ Types of earth rods
  - ✓ Types of wires
  - ✓ Size and specification of wires

Resources required for the indicative content

Equipment	Inverter, Battery, Grinding machine, Drilling machine, Solar
Materials	Electric cables, Junction Box, Lamps, Socket plug, Lamp holder, Electrical wires, Earth wire, Mild Steel tube
Tools	Screw Driver kit, Pliers Kit, Measurement tape, Spirit Level, Hack saw, Electric knife, Spanners Kit, Electrical wire short, Ladder, Notebook / Pen
Facilitation techniques & learning activities	• Demonstration and simulation • Individual and group work • Practical exercise

	• Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Product based assessment • Project based assessment

Integrated/Summative assessment (For specific module)

Integrated situation

Mr Nzaramba Pierre living in Ngoma District in remote area where there are no electricity grids. He wants to install solar home system in his new house as follows:

1. Living room has one entrance and one exit with two lamps (9W, 220V, 50Hz) each.
2. Bed room has one entrance with one lamp (9W, 220V, 50Hz).
3. Two socket outlets (400W, 220V, 50Hz) each.

You as PV system installer you are requested to design, mount and install this PV system within 6hours

Resources

Tools	Screw Driver kit, Pliers Kit, Measurement tape, Spirit Level, Hack saw, Electric knife, Spanners Kit, Electrical wire short, Ladder, Notebook / Pen
Equipment	Inverter, Battery, Grinding machine, Drilling machine, Solar
Materials/ Consumables	Electric cables, Junction Box, Lamps, Socket plug, Lamp holder, Electrical wires, Earth wire, Mild Steel tube

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
Learning outcome 1: Design solar PV system component **(35%)**	1.1. Total Energy Demand is properly described	Electrical Appliances are identified			3
		Appliances wattage ratings are properly Described			3
		Appliance types are identified			3
	1.2. Solar PV system components are correctly sized	Solar PV panels sized			5
		Battery bank is sized			5
		Inverter and charge controller are sized			5
		Protective devices Wires and cables are sized			5
	1.3. Solar PV system components are properly selected based on standards	Panels are selected			2
		Battery and charge controller are selected			2
		Wires and load are selected			2
		Tools are selected			2

Learning outcome :Set the site **(25%)**	2.1. Materials, equipment and tools are properly selected according to the work to be done	Materials are selected			2
		Equipment are selected			2
	2.2. The drawings are properly interpreted as per design	The drawings are properly interpreted			2
		Scale is applied			2
	2.3. The dimensions are Precisely taken and correctly marked based on direction of sun direction	Tape Measure is correctly used			2
		The dimensions are red			2
		Position are marked			2
	2.4. The materials for structural support are properly prepared according to the drawings	Structure support is formed			2
		Metal are cu			1
		Holes are drilled			1
	2.5. The structural support are properly assembled and fixed according to the design	Keys are properly used			1
		Angle are measured			1
		Bolts and nuts are tightening			1
Learning outcome 3:mount solar PV panels **(15%)**	3.1. Prefabricated support is carefully mounted	the site is selected			4
		The support is mounted			2
	3.2. The solar PV Panels are properly fixed on prefabricated structural support with appropriate bolt and nuts according to the drawing	The panels are fixed			2
		The bolts are selected			2
	3.3. PV modules are properly Interconnected according to the design	The PV module are properly interconnected			2
		Series and parallel connection			2
	3.4. Distribution board is Properly connected to PV Panels based on the drawing	Distribution Board selected			2
		Type circuit breaker is installed			2

		Location is identified			1
Learning outcome 4:interconnect solar PV system components **(15%)**	4.1. Tools are properly selected according to the work to be done.	Tools are selected			2
		Materials are selected and used			2
	4.2. The PV system components are properly selected according to the size of the PV system	PV panels are selected			2
		Battery are selected			2
		The inverter is selected			2
	4.3. The PV system components are properly connected according to polarities indications.	PV panel are connected to charge controller			2
		Batteries are connected to charge controller			1
		Batteries are connected to the loads			1
	4.4. The continuity of the wires are properly Checked according to the work done	Continuity of the wires is properly checked			1
Learning outcome 5:connectprotective devices **(10%)**	5.1. Surge Protective Device and circuit breakers are properly installed	Surge protective devices are properly installed			2
		Circuit breakers are properly installed			
	5.2. Tools, materials and equipment for earthing are properly selected based on the installation to be earthed	Tools for earthing are properly selected			2
		Materials for earthing are properly selected			2
	5.3. Earthing protection is properly done based on standard	Earthing protection is properly installed			2
	5.4. Earth rods and wires are properly fitted in accordance with earth resistance	Earth rods and wires are properly fitted			5
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate): 70%					

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