Skill India
कौशल भारत - कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

Facilitator Guide

Sector
Agriculture

Sub-Sector
Forest, Environment and Renewable Energy Management

Occupation
Renewable Energy Management

Reference ID: **AGR/Q6701,** Version **3.0**
NSQF Level: **4**

Solar Pump Technician

Scan this QR to access eBook
https://eskillindia.org/Home/handbook/176

Published by
Agriculture Skill Council of India
6th Floor, GNG Building, Plot No.10
Sector - 44, Gurugram - 122004, Haryana, India
Email: info@asci-india.com
website: www.asci-india.com
Phone: 0124-4670029, 4814673, 4814659

Second Edition, March 2023
This book is sponsored by Agriculture Skill Council of India (ASCI)
Under Creative Commons Licence: CC BY-NC-SA:
Attribution-ShareAlike: CC BY-NC-SA:

This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format for non commercial purposes only, and only so long as attribution is given to the creator. If you remix, adapt, or build upon the material, you must license the modified material under identical terms.

Disclaimer

The information contained herein has been obtained from sources reliable to Agriculture Skill Council of India (ASCI). ASCI disclaims all warranties to the accuracy, completeness or adequacy of such information. Agriculture Skill Council of India shall have no liability for errors, omissions, or inadequacies, in the information contained herein, or for interpretations thereof. No entity in Agriculture Skill Council of India shall be responsible for any loss whatsoever, sustained by any person who relies on this material. The coded boxes in the book called Quick Response Code (QR code) will help to access the e resources linked to the content. These QR codes are generated from links and you tube video resources available on Internet for knowledge enhancement on the topic and are not created by ASCI. Embedding of the link or QR code in the content should not be assumed endorsement of any kind.

Agriculture Skill Council of India is not responsible for the views expressed or content or reliability of linked videos. ASCI cannot guarantee that these links/QR codes will work all time as we have no control over availability of linked pages.

> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

Acknowledgements

We are thankful to all organizations and individuals who have helped us in preparation of this Facilitator Guide. We also wish to extend our gratitude to all those who reviewed the content and provided valuable inputs for improving quality, coherence and content presentation of chapters. This Facilitator Guide will lead to successful roll out the skill development initiatives, helping greatly our stakeholders particularly trainees, trainers and assessors etc. We are thankful to our Subject Matter Expert for the content and helping us in preparation of this Facilitator Guide.

It is expected that this publication would meet the complete requirements of QP/NOS based training delivery. We welcome the suggestions from users, industry experts and other stakeholders for any improvement in future.

About this Guide

The objective of the guide is to provide an approach map for interacting with the trainees undergoing training on the job role. The aim of the course is to provide both theoretical and practical knowledge to the trainees, and also to guide them.

The guide is neither a substitute nor complete road map, but an aid to help you to pass on the knowledge on all the aspects to the trainees in a systematic manner. It is expected that the trainer is fully conversant with all the contents of the handbook. The guide is just to indicate that how to proceed for covering a topic and includes some additional information that may be necessary for the trainer to develop better comprehension.

Facilitator with the help of this guide will be able to build among participants:

- **Knowledge and Understanding:** Satisfactory operational learning and comprehension to play out the required chore
- **Performance Criteria:** Pick up the required aptitudes through hands on preparing and play out the required operations inside the predetermined measures
- **Professional Skills:** Capacity to settle on operational choices relating to the zone of work

The job will also help them learn more by field visits and providing hands on training. It is expected that irrespective of the region, knowledge on all aspects of Solar Pump Technician will be imparted to trainees.

Symbols Used

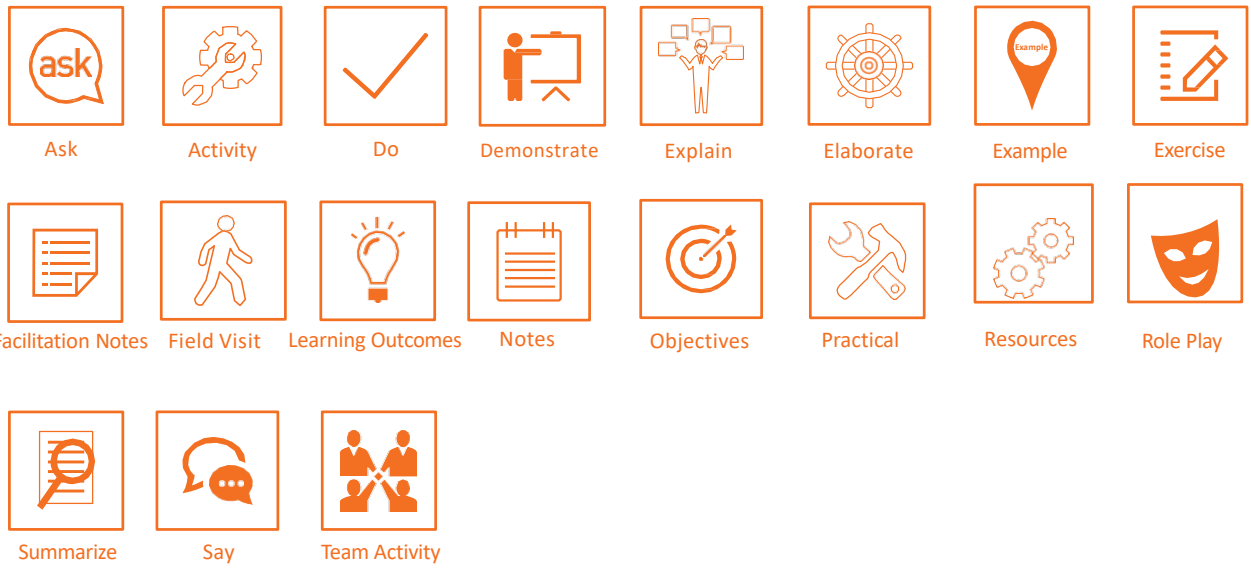
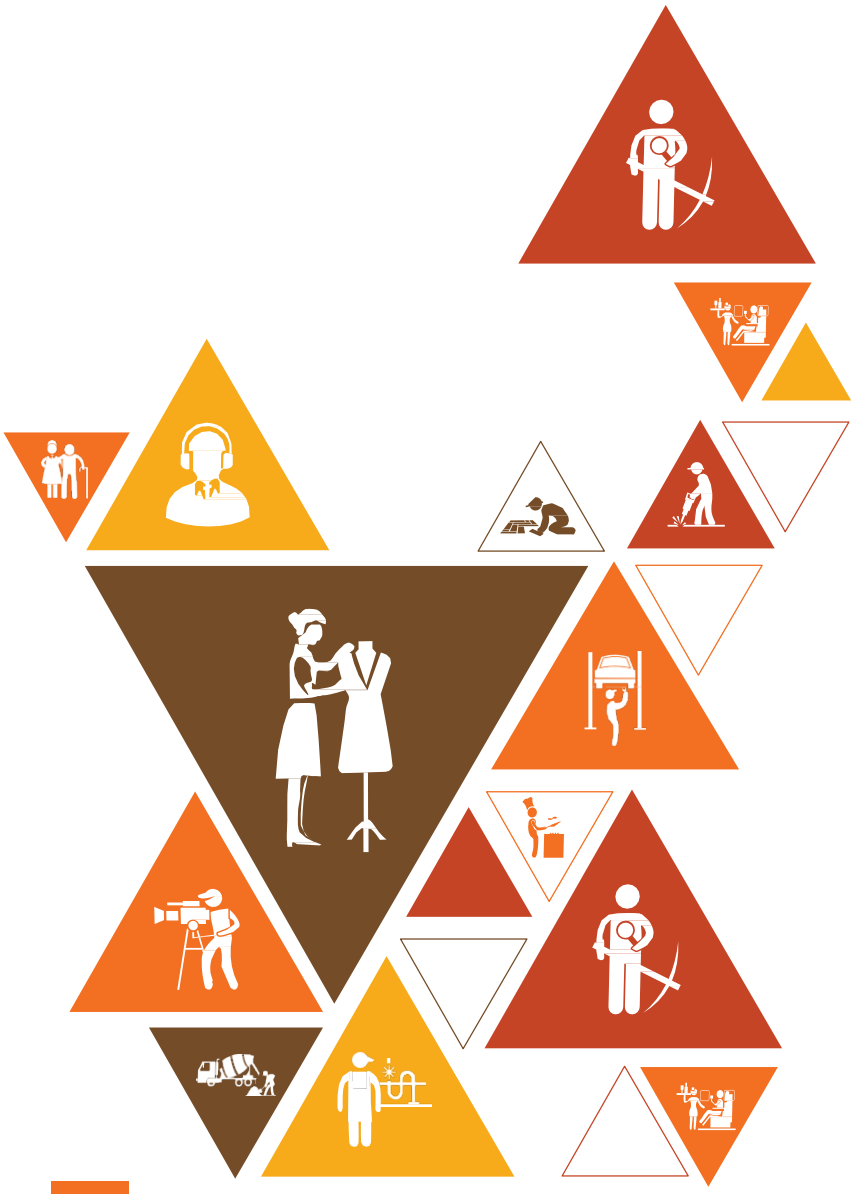


Table of Contents

S.No.	Modules and Units	Page No.
1.	**Introduction to the Role of a Solar Pump Technician**	**1**
	Unit 1.1 - Importance of Solar Pump in Agriculture	3
2.	**Process of Conducting Site Assessment and Planning the Solar Pump Installation(AGR/N6701)**	**7**
	Unit 2.1 – Code of Conduct during Site Visit	9
	Unit 2.2 – Energy, Its Uses and Sources	11
	Unit 2.3 – Basics of Electrical Circuit	14
	Unit 2.4 – Basics of Electronics	17
	Unit 2.5 - Assessment of Site Installation	20
3.	**Installation of Solar Panel and Battery (AGR/N6702)**	**25**
	Unit 3.1 - Working of Solar Photo Voltaic Cells and Panels	27
	Unit 3.2 - Mounting and Its Types	29
	Unit 3.3 - Batteries	31
	Unit 3.4 - Inverters	33
	Unit 3.5 - Installation of PV system	35
4.	**Installation of the Plumbing System and Water Pump (AGR/N6703)**	**39**
	Unit 4.1 - Basics of Plumbing	41
	Unit 4.2 - Pumps and Its Types	43
	Unit 4.3 - Solar Pumping System and Installation	45
5.	**Repair and Maintenance of Solar Pump Setup (AGR/N6705)**	**49**
	Unit 5.1 - Maintenance and Its Importance	51
	Unit 5.2 - Monitoring Technical Issues and Repair of Solar Pump	54
6.	**Safety Procedures at Workplace (AGR/N9953)**	**58**
	Unit 6.1 - Handling of Hazardous Waste	60
	Unit 6.2 - Creation of Safe Working Environment	62
7.	**Employability Skills 60 Hours (DGT/VSQ/N0102)**	**66**
	To access MSDE Upgraded Employability Skills, click here: https://eskillindia.org/NewEmployability	
8.	**Annexures**	**68**
	Annexure I - Training Delivery Plan	69
	Annexure II - Assessment Criteria	78
	Annexure III - QR Codes – Video Links	79



Skill India
कौशल भारत-कुशल भारत

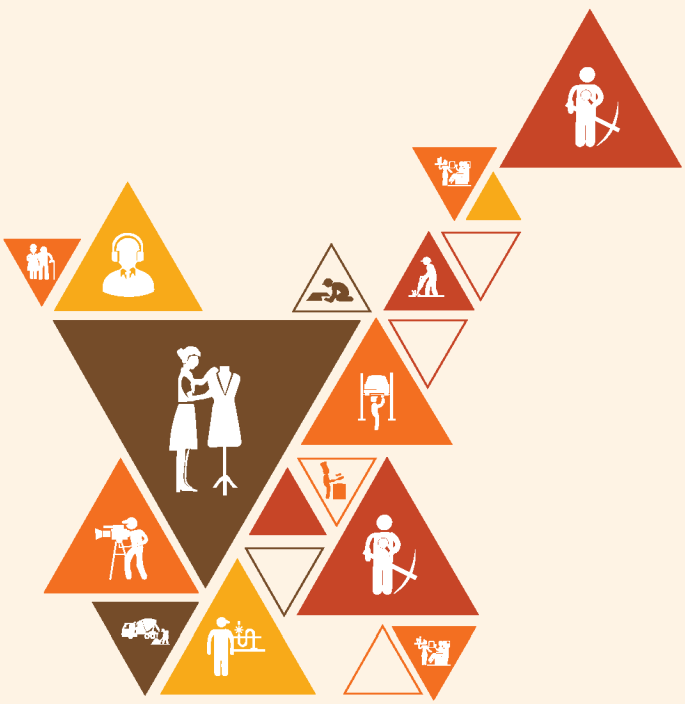
सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

1. Introduction to the Role of a Solar Pump Technician

Unit 1.1 - Importance of Solar Pump in Agriculture



Bridge Module

Key Learning Outcomes

After the completion of this module, the participant will be able to:

1. Describe the size and scope of the Agriculture industry and its subsectors.
2. Discuss the role and responsibilities of a Solar Pump Technician.
3. Discuss various employment opportunities for a Solar Pump Technician.

UNIT 1.1: Importance of Solar Pump in Agriculture

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain solar power industry in India and its Scope.
2. Explain the importance and benefits of Solar pump system in agriculture.
3. Discuss the role and responsibilities of a Solar Pump Technician.
4. Discuss various employment opportunities for a Solar Pump Technician.

Resources to be Used

- Available objects such as a participant handbook, pens, sticky notes, computer, projector, white board, duster, markers, flip charts, pen, notebook, laser pointer etc.
- Power point slides or pictures or posters indicating importance of solar pump in agriculture.

Say

- Welcome the participants and thanks everyone for their participation in this training program.

Ask

- Can you list out benefits of solar water pumps?

Elaborate

With the help of Participant handbook and audio visual aids, elaborate:

- Solar power industry in India
- Importance of solar water pumping system in agriculture
- Roles and Responsibilities
- Employment opportunities

Activity

Purpose : To aware about schemes related to solar power.

Methodology: Pen and paper activity .

Tentative time : 30-40 minutes.

Material required: Checklist, notebook, pen/pencil

Procedure

- Ask the participants to list out the schemes in their area for solar power or other renewable power systems and note down the various benefits of each.
- Find the schemes on the basis of following characteristics:
  - ✓ Subsidies on purchase or installation of solar system
  - ✓ Free schemes by government in their state
  - ✓ Tax rebate
  - ✓ Loans available at various institutes
- After these, ask any one of the participants to share his/her listed schemes in front of the class.
- Encourage other participants to actively engage in the class activity.

Notes for Facilitation

- Assist the participants to know about importance of solar pump in agriculture.
- Pre arrange slides/charts or visuals for better understanding of the topic.
- Ask the students if have any doubts regarding the topic.
- Wherever possible, involve the participants for peer learning.

Exercise

Key Solutions to PHB Exercises

1. Benefits of solar water pumps:
   - Solar water pumps are clean source of energy and produces cost effective energy as compared to diesel pumps.
   - It can be used for various purposes like irrigation, livestock, and portable drinking water.
   - Solar water pumps are easy to maintain.
   - Solar pumps can store excess water in storage tanks for usage when there is no energy or bad weather.
2. Following are the roles and responsibilities of a Solar pump technician :
   - Be able to inspect, prepare the site of installation to ensure smooth installation process.
   - Arrange for the material, equipments and tools for the Photovoltaic Solar Pump.
   - Installation of the solar pumps at the site as per the guidelines and specifications.
3. This is a practical exercise to be undertaken by participants for their respective area.

Notes

Skill India
कौशल भारत-कुशल भारत

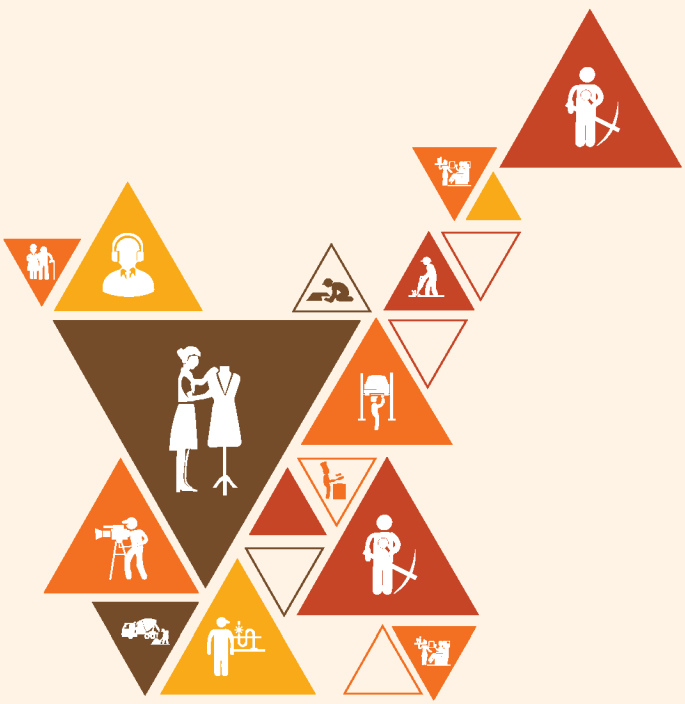
सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

2. Process of Conducting Site Assessment and Planning the Solar Pump Installation

Unit 2.1- Code of Conduct during Site Visit
Unit 2.2 - Energy, Its Uses and Sources
Unit 2.3 - Basics of Electrical Circuit
Unit 2.4 - Basics of Electronics
Unit 2.5 - Assessment of Site Installation



AGR/N6701

Key Learning Outcomes

After the completion of this module, the participant will be able to:

1. Explain the business code of conduct to be followed during the site visit and customer dealing.
2. Describe the process of conducting a site visit for the purpose of installing a solar pump.
3. List various parameters to assess to find an ideal spot for the installation of a solar pump and panels.
4. Describe the process of planning the installation of a solar pump according to the site and client's requirements.
5. List various resources required for the installation of a solar pump and panels.

UNIT 2.1: Code of Conduct during Site Visit

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Demonstrate the business code of conduct to be followed during the site visit and customer dealing.
2. Communicate with farmers and co-workers and identify the frequency of visits and follow-ups.

Resources to be Used

- Available objects such as a participant handbook, white board, duster, flip chart board/paper etc.
- Slides in power point presentation showing relevant images.

Ask

- What do you mean by communication?
- What do you understand by interpersonal communication?

Elaborate

- Understand the problems of Farmer
- Coordinate and Follow up with Farmer/Co-worker
- List of code of conduct during Site visit

Field Visit

Purpose : To enhance the knowledge on techniques of solar pump.

Methodology : Field visit and the time varies according to the location, it may be 2 hours.

- Arrange a site visit.
- Ask the participants to interact with farmers.
- Discuss the problems faced during the site visit and interact with people.

Do

- Ask any one member of the team to present the assigned topics and share it among their peers.
- At the end of each presentation, clarify all the doubts of the students.
- Motivate the students to ask questions after each presentation.
- Review presentation of each group and add your comment with additional information/corrections.

Notes for Facilitation

- Students must be encouraged for going through the participant handbook and come prepared with thorough reading.

Exercise

Key Solutions to PHB Exercises

1. This is a practical exercise to be undertaken by participants for their respective area.

UNIT 2.2: Energy, Its Uses and Sources

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain the various sources of energy.
2. Discuss the importance of solar energy and its extent in India.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Chart papers.
- Stationary items like pen, pencil, colored markers, double-sided tape, scissor, blank A4 papers etc.
- PowerPoint slides on Energy and its uses.
- Video film on types of energy.

Ask

- What is energy?
- What are types of energy?
- What do you think the energy comes from?

Elaborate

- Energy
- Types of energy
- Sources of energy
- Solar energy and its advantages
- Energy conversion and power generation

Activity

Purpose: To acquaint about the solar energy. This activity may be planned for 1-2 hours.

Methodology : Pen and per activity

- Ask participants to collect some photographs (at least 2-3) of solar technology around them and take notes about it in the next class.
- Tell them that each participant will present 5 points to the group about the solar technology.
- Point out the advantages and disadvantages of solar energy.

Say

- In today's era where environment pollution is at its peak and other non-renewable sources have been exhausted, renewable sources of energy like solar energy is the solution to clean energy called 'Green Power'.

Team Activity

Purpose: To acquaint about the various aspects of energy. This activity may be planned for 15-20 minutes.

Methodology : Pen and per activity

- Divide the class into 5 teams.
- Assign one topic to each group from below list.
  - ✓ Energy
  - ✓ Types of energy
  - ✓ Sources of energy
  - ✓ Solar energy and its advantages
  - ✓ Energy conversion and power generation
  - No team should be given the same topic.
  - Give sufficient time for teams to refer to the text in participant handbook related to assigned topics and discuss among themselves.

Do

- Ask any one member of the team to present the assigned topics and share it among their peers.
- At the end of each presentation, clarify all the doubts of the students.
- Motivate the students to ask questions after each presentation.
- Review presentation of each group and add your comment with additional information/corrections.

Notes for Facilitation

- Ensure that all the participants are well equipped with energy, its source and its uses.
- Pre arrange slides, posters and visuals on energy and its sources.
- Arrange innovative videos related to solar energy.
- Give examples of Kinetic Energy (KE) and Potential Energy (PE) and ask the participants to calculate KE.
- Make the class more participatory.

Exercise

Key Solutions to PHB Exercises

1. (A) Energy conversion
2. (B) Chemical energy
3. Energy is the capacity of the physical system to do some work. The total effort required to do a work is termed as energy. Four types of energy are kinetic energy, potential energy, thermal energy and chemical energy.
4. (A) The sun
5. (A) A car sitting at the top of a hill.
6. Non-renewable sources-coal, natural gas, oil.
7. Renewable energy sources-solar, wind, ocean.

UNIT 2.3: Basics of Electrical Circuit

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Define basic terminologies in electrical circuit.
2. Explain the various forms of current.
3. Demonstrate how circuit works.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Chart papers
- Stationary items
- PowerPoint slides on basic terminologies in electrical circuit.
- Materials for the practical exercises like multimeter, battery, wires to complete the circuit, resistor etc.

Ask

- What they understand by current, voltage and resistance?
- Do anyone have heard of the terms, AC and DC circuit?

Elaborate

- Electricity and its terminologies
  - ✓ Voltage
  - ✓ Current
  - ✓ Resistance
- Current (AC/DC) and voltage
- Circuits ad its types
- Measuring instruments and wiring connections
- Precautions and safety measures for handling electric equipment

Demonstrate

- Demonstrate the use of multi meter to the participants.
- Show participants the correct method of reading voltage, current, resistance.
- During demonstration ask the participants to observe the whole process carefully.

Activity

Purpose: To give hands on training on multi meter. This activity may be planned for 30-40 minutes.

Methodology : Practice with multi meter

- Ask the participants to do practice session by giving them the multi meter individually.
- See if the participants are doing it as per demonstrated way or not.
- Point out the safety and handling measures to be taken and ask participants to repeat the same.

Practical

- Facilitators should arrange for the following instruments and do a practical demonstration of various types of circuits with use of battery, diode, resisters, wire.
- Divide participants in 3-4 groups and if possible, let each group understand and brainstorm about various types of circuits.
- Ask the groups to practice combination of various circuits.
- Materials required:
  - ✓ Circuit
  - ✓ Battery
  - ✓ Resistors
  - ✓ LED
  - ✓ Multi meter
  - ✓ Safety tools
  - ✓ Junction box
  - ✓ Insulation

- Practice Indicators:
  - ✓ See carefully the demonstration of various circuits (in series and parallel) and use of each Instrument done by facilitator. Ask questions.
  - ✓ Try combination of various circuits.
  - ✓ Practice the flow of current in various circuits.
  - ✓ Voltage levels at various points in circuit.
  - ✓ Measure current, voltage in the circuits using multi meter
  - ✓ Connect junction box while joining the circuits.
  - ✓ Do insulation of wires.
  - ✓ Install fuse in the circuit.
  - ✓ Do earthing.
  - ✓ Identify the types of wiring and how they are connected from DC and AC input/output.

- **Caution:** Facilitators should warn participants about the safety measure while handling these electrical instruments.

Notes for Facilitation

- Explain the various terms associated with electricity such as current, voltage, resistance, etc. Discuss and demonstrate circuit and its types.
- Address the queries of the participants related to the topic.
- Organize a visit to nearby electrical lab to show the electrical circuit and instruments.
- Advice the participants to take safety precautions while handling electric equipment.

Exercise

Key Solutions to PHB Exercises

1. In the figure 2.2.3, pressure (voltage) in tank two is more than the left tank. So in terms of law, second tank should have more flow, but here since the width (resistance) in the second tank is restricting the flow, both tanks will have same rate of outflow of water (current).
2. Electricity is defined as the flow of electrons which supplies current to various gadgets. Voltage is the difference in charge between the two points. Electricity always flows from a higher voltage level to a lower voltage level. Ammeter is device used to calculate electricity and voltmeter is device used to calculate the voltage.
3. Refer to section 2.2.2-Current (AC/DC) and voltage
4. Short circuit is a circuit where high voltage (positive) is connected to the negative source and there is no resistance or component in the circuit. This is a bad idea and, in this case, current keeps on moving indefinitely and there will be nothing to stop the current and can create damage.
5. Multimeter is a device which helps in identifying where the circuit is open and gives reading of voltage at various points in the circuit.

Steps to measure voltage using multimeter:

- Put black probe in COM port and red probe in mAVΩ port.
- Set multimeter to 2V in the direct current (DC).
- Now, you have to connect black probe of the multimeter to the ground of the battery or negative side and connect red probe to the positive side.
- Now you have to hold both the ends of the battery along with probes and press a little.
- You can read the voltage reading on the display panel.
- For calculating the alternating current, use the V with wavy sign after it (V~).

UNIT 2.4: Basics of Electronics

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Discuss about electronics.
2. Explain various components of electronics and their usage.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Chart papers
- Stationary items
- PowerPoint slides or pictures of various components of electronics
- Materials like Multimeter, Voltmeter, Wattmeter, Diodes, Capacitor, Resistor, Inductor for practical

Ask

- What is an electronic circuit?
- What do you mean by conductor and insulator?
- Can you list some of the measurement & analysis instruments?

Elaborate

- Electronics
- Electronic circuit and its symbols
- Electronic components
- Measurement and analysis instruments

Do

- Do the following demonstration to the participants step by step. Draw each circuit on board and explain the flow of current at each step. This will help participants in understanding the basic concept of a capacitor.
- Once you have explained, ask one of the participants to reiterate and tell the whole class about it.

Activity

Purpose: To understand about conductors & insulators. This activity may be planned for 15-20 minutes.

Methodology : Pen and per activity

- Ask the students to list out good and bad conductors of electricity.
- Discuss with the participants the role of these conductors and insulators in electric circuit.

Practical

- Give participants various combinations of circuit and discuss the flow of current and principle of working of capacitor, use of inductor and how to read various instruments for better understanding.
- Ask the participants to connect the electronic items in electric circuits.
- Materials required:
  - ✓ Conductor Material
  - ✓ Insulator Material
  - ✓ Resistors of different resistance
  - ✓ Capacitors
  - ✓ Diodes
  - ✓ Transistor
  - ✓ Ammeter
  - ✓ Voltmeter
  - ✓ Multimeter
  - ✓ Circuits
  - ✓ Wires
- Practice Indicators:
  - ✓ See carefully the demonstration of various electronic instruments, their use, its components and working.
  - ✓ See various applications of each electronic instrument.
  - ✓ Learn to connect the electronic items in electric circuits.
  - ✓ Calculate the voltage, current and capacity in different combination of circuits.
  - ✓ Learn the functioning of each electronic item.
  - ✓ Usage of Multimeter functions and their readings.
  - ✓ Colour coding for different resistors and do some problems on it.
  - ✓ Identify the resistor values by observations.
  - ✓ Voltage measurement of batteries through a Multimeter.

Notes for Facilitation

- Assist the groups to understand the topic clearly through visualization.
- Skill demonstration on electronic circuit may be provided.
- Constantly motivate each student to participate to improve their presentation skill, use of tools, etc.
- Encourage the participants to experience hands on training through practical assignments.
- Give exercises to participants to calculate resistance in the circuit.

Exercise

Key Solutions to PHB Exercises

1. Conductors-gold, silver, copper, steel, Insulators - Rubber, glass, oil, dry wood
2. Resistor is the most basic component used in the electronic circuits which resists the flow of current. The resistor is used to reduce the flow of the current.
3. Ammeter: An ammeter is a device which is used to measure current in the circuit whether it is direct or alternating current.
   - Voltmeter: A voltmeter is a device used to calculate the voltage or potential difference in the circuit at any two points.
   - Multimeter: The Multimeter is a multipurpose device which measures several components with one instrument only like voltage, current and resistance.
   - Waltmeter: The waltmeter measures the power of the electric system in any circuit.

4. Voltage: It is the difference in charge between the two points. V=I.R
   - Current: It the rate at which the charge is moving in the circuit. I=V/R
   - Power: It is the amount of energy transferred or converted per unit time. P=W/T
   - Energy: It is the capacity of the physical system to do some work. Energy=Power x Time

5. Voltage drop is the decrease of electrical potential along the path of a current flowing in an electrical circuit. For example, an electric space heater may have a resistance of ten ohms, and the wires that supply it may have a resistance of 0.2 ohms, about 2% of the total circuit resistance. This means that approximately 2% of the supplied voltage is lost in the wire itself.

UNIT 2.5: Assessment of Site Installation

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Process of conducting site visit.
2. Assess and identify the location of installation.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Chart papers
- Stationary items
- Power Point slides or videos on site assessment
- Notebook for practice for the participants

Ask

- What is the importance of site assessment?
- What parameters should be kept in mind while doing the site assessment?

Elaborate

- Site assessment and its importance
- Location of installation
- Daily water requirement
- Water sources
- Water delivery
- Selection of location
- Selection of solar panel capacity and design
- Calculation of rate of flow

Practical

- **Objective:** Site assessment for installing solar power pump
- **Materials required:** Pen, Paper, Scales
- Take participants to a site where they need to install power system.
- Divide the participants in 3 groups.
- Ask each group to do the site assessment and calculate all the required parameters as learnt in this section.

- After coming to the classroom, each group will present the following findings:
  - ✓ Is site suitable for installation of solar power pump? Why and why not?
  - ✓ What kind of specifications they will install in their PV system and Why?
  - ✓ Capacity of each component
  - ✓ Approximate installation cost and time

- Practice Indicators:
  - ✓ Topographical angles and directions
  - ✓ Area of irrigation
  - ✓ Daily water requirement
  - ✓ Water sources
  - ✓ Water table
  - ✓ Seasonal variations
  - ✓ Solar angle
  - ✓ Calculation of the rate of flow, capacity of pump required, solar panel capacity, pipe length
  - ✓ Installation cost by figuring out the rates from different

Say

- Appreciate each group for the efforts and discuss the missing information after the presentation.

Notes for Facilitation

- Explain the importance of site assessment
- Encourage the participants to have hands on practical experience.
- Assist the participants to calculate flow rate of water in different seasons.
- Organize a field visit to a site to enhance their learning.
- Invite solar pump technician to share some knowledge on how to select proper site for pump installation.

Exercise

Key Solutions to PHB Exercises

1. Three major components /parts used in the solar pump system are electric motors, pump controllers, battery, invertor, water pump, etc.
2. The process of site assessment for solar pump installation:
   - Location of installation
   - Daily water requirement
   - Water sources
   - Water Delivery
3. Indicators for procurement of material for installation are:
   - Choose the manufacturer which provides whole mechanism which includes solar modules/arrays, connecting cables, structures to fit in solar panels (mounting structure), standing pole structures, and instruction manual.
   - Always read the manufacturer's instructions to ensure the specificities.
   - Check the guarantee period.
   - Take into account the maintenance cost of the system you purchase.
   - If you purchasing from different manufacturers, it is important to talk about the compatibility of all parts.
   - Wiring of the solar panels in the array and with the system controller must be according to the India standards. Wiring should be chosen such that it offers minimum electrical losses.
   - Consider all safety measures while handling electrical instruments like earthing, short circuits etc.
4. Refer to section 2.5.2-Indian standards on Renewable Energy notified by BIS.

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

3. Installation of Solar Panel and Battery

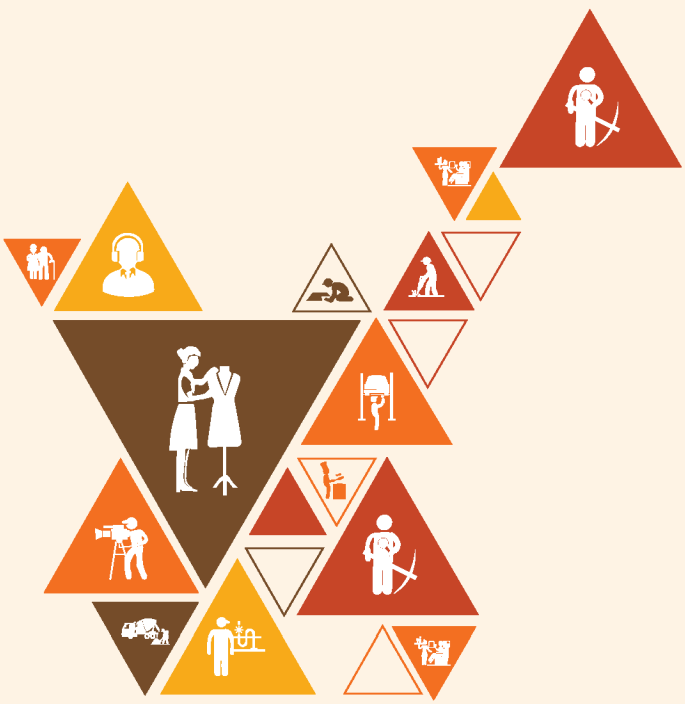
Unit 3.1 - Working of Solar Photo Voltaic Cells and Panels

Unit 3.2 - Mounting and Its Types

Unit 3.3 - Batteries

Unit 3.4 - Inverters

Unit 3.5 - Installation of PV system



AGR/N6702

Key Learning Outcomes

After the completion of this module, the participant will be able to:

1. Describe the process of installing the solar cable, plugs, spare fuse, solar panels and battery.
2. Describe the process of testing battery and system voltage.
3. Explain the importance of leaving a clean site after completing the solar pump installation.

UNIT 3.1: Working of Solar Photo Voltaic Cells and Panels

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain importance of photo voltaic cells.
2. Demonstrate the working of solar cells and panels.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Chart papers
- Stationary items like pen, pencil, colored markers, double-sided tape, scissor, blank A4 papers etc.
- PowerPoint slides or videos on solar photo voltaic cells and panels.
- A photovoltaic or solar cell for demonstration.

Ask

- What do you mean by photovoltaic cells and panels?
- What are three types of solar PV panels?

Elaborate

- Photo voltaic cells, panels and its importance
- Advantages and disadvantages of solar PV panels
- Types and design

Demonstrate

- Show a solar photovoltaic (PV) cell to the participants and ask if they know what it is. Demonstrate the components & working of photovoltaic cells.

Activity

Purpose: To understand about Solar PV panels. This activity may be planned for 15-20 minutes.

Methodology : Group discussion

- Ask the participants about the use of solar PV panels and discuss.
- Add if participants miss any point.
- Encourage participants to speak and have a discussion.
- Listen their opinions and why do they think so.
- Explain about the designs and types of photovoltaic technology and its characteristics.

Notes for Facilitation

- Make sure the participants are well equipped with different types of photovoltaic cells.
- Indicate potential sources of information.
- Arrange the pictures of various types of photovoltaic cells.
- Relevant videos and YouTube links related to solar voltaic cells and panels may be shown to the participants.

Exercise

Key Solutions to PHB Exercises

1. Working of photovoltaic cells:
   - Photovoltaic cells absorb sun rays and knock electrons loose.
   - Sunlight falls on the semiconductor material and it knocks down the electrons in the material loose.
   - Electrons flow and generate current.
   - These loose electrons start flowing in the semiconductor to produce current. Layers of silicon are treated and one layer is positively charged and other is negatively charged thus producing electric current in one direction.
   - Electric current is captured in metal plates.
   - Once the electric current is generated in the field, the metal plates being conductors, collect the same and transfer them wires attached. These wires are connected to solar invertors and then is supplied wherever required.

2. Three types of solar PV panels are:
   - Mono crystalline solar PV panel
   - Polycrystalline solar PV panel
   - Thin film PV (amorphous) panels

3. These are:
   - Open-circuit voltage (VOC)
   - Short-circuit current (ISC)
   - Operating voltage (VMP)
   - Operating current (IMP)
   - Maximum power (PMP)
     - ✓ Polarity of terminals
     - ✓ Maximum permissible system voltage

UNIT 3.2: Mounting and its Types

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Identify the types of mounting option for solar panels.
2. Describe the process of mounting.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Chart papers
- Stationary items like pen, pencil, colored markers, double-sided tape, scissor, blank A4 papers etc.
- PowerPoint slides on the topic.
- Pictures or illustrations on different mounting structures.

Say

- Greet the participants and revise the key learnings of previous session discussion.

Elaborate

- Mounting and its types
- Advantages and disadvantages of ground and roof mounting

Ask

- What do you mean by mounting?
- Why the mounting structures are needed for photovoltaic systems?
- What are the different types of mounting?

Team Activity

Purpose: To understand advantages and disadvantages of different types of mounting. This activity may be planned for 10-15 minutes.

Methodology : Group discussion pen & paper activity

- Divide into two groups, Group A and Group B.
- Tell Group A to list down all the advantages of ground and roof mounting.
- Tell group B to list down all the disadvantages of ground and roof mounting.

- After the end of the team activity, ask one member of Group A to tell the advantages and write the points on the whiteboard.
- Ask one member of Group B to tell the disadvantages and write the points on the whiteboard.
- Add any point missed by the participants.
- Share your own expert advice or opinions regarding mounting.

Notes for Facilitation

- Discuss mounting and its types.
- Facilitators may use rotational basis for individuals or in groups to take up different activities, answering the question, etc.
- Plan a visit to site to show them mounting structures.
- Enhance participation of students in the discussion and activities.

Exercise

Key Solutions to PHB Exercises

1. Ground mounting structures can be fixed or can have adjustable tilt to support the season variants.
   - Pole mounting is the mounting where PV arrays are mounted above a certain height on ground using poles.
   - Roof Mounting is the mounting system which is done mostly for home PV solar systems or for commercial buildings or when enough open area is not available on ground.

Ground Mounting:
Advantages
- Ground mounting is easy to install and inspect. No need to climbing.
- Tilt can be chosen easily in ground mounting.

Disadvantages
- A lot of unrestricted place is required.
- When tilted PV modules are placed very nearby, they sometimes create shade on one another.

Roof Mounting:
Advantages
- Saves space and utilizes unused space.
- Economical.

Disadvantages
- Difficult to install in slanted roof structures.
- Require ensuring the roof structure to bear the weight which might lead to additional cost.

UNIT 3.3: Batteries

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain batteries, types, their usage and working.
2. Connect the invertors in the solar panel system design.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Stationary items like pen, pencil, colored markers, double-sided tape, scissor, blank A4 papers chart papers etc.
- Power point slides on battery and its types.
- Batteries and invertors for demonstration, if possible.

Ask

- What are batteries? What does a battery do?
- What kind of battery is used in solar PV systems?

Elaborate

- Battery and its types used in solar power systems
- Lead acid battery
- Connections and design
- Handling and safety

Demonstrate

- Demonstrate on white board the placement of the battery in the solar pump system and the safety measures to be taken while handling batteries.
- Motivate the participants to observe the demonstration carefully.
- During demonstration clarify all doubts of the participants.

Activity

Purpose : To identify the components of lead acid battery. Time may be planned for 15 minutes.

Methodology : Pen and Paper activity

Procedure

- Display the pictures of different components of Lead acid battery on projector.
- Provide each student answer sheet.
- Ask the participants to identify them and note down the answers in their answer sheets.
- See if they have correctly identified the component or not.
- Motivate them to engage them in activity and clear doubts of the participants.

Notes for Facilitation

- Explain the safety measures that should be taken while dealing with a battery.
- Tell them to wear proper clothes while handling the batteries.
- Video film may also be used to show operation of batteries.
- Clarify all the doubts of the participants.
- Show more innovative images as per topic requirements for better understanding of the topics.

UNIT 3.4: Inverters

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain inverters, their working and design.
2. Connect the inverters in the solar panel system design.

Resources to be Used

- Computer, projector, whiteboard and markers.
- Stationary items like pen, pencil, colored markers, double-sided tape, scissor, blank A4 papers chart papers etc.
- Power point slides on Inverters.
- Batteries and invertors for demonstration, if possible.

Ask

- What is an inverter?
- Name different types of inverters.

Elaborate

- Inverters
- Classification of inverters
- Inverter key specifications
- Balance of system (BOS) components

Field Visit

Purpose : To enhance the knowledge on inverters.

Methodology : Field visit and the time varies according to the location, it may be 2 hours.

- Arrange a visit to show inverters installed in the premises.
- Explain to them how inverter works.
- Motivate the participants to observe the working of inverter carefully.
- At the end of the activity, conduct a doubt clarification session.
- Share your own thoughts and insights and encourage them.

Notes for Facilitation

- Ask the participants if they have any questions and clarify all doubts of the participants
- Discuss with the participants regarding the working of inverters.
- Encourage peer learning among participants in the class by answering other participant's questions.
- Prepare or procure teaching learning materials for an understanding the different types of inverters.
- A solar pump technician may also be invited to take these sessions.

Exercise

Key Solutions to PHB Exercises

1. A power inverter or inverter is an electrical power converter that changes direct current (DC) to alternating current (AC). It converts the energy from DC to AC through an electrical switching process.
2. Different types of Inverters are:
   - Stand-Alone Inverters
   - The grid tie inverter
   - The battery backup inverter
   - Sine wave inverter

   Stand-Alone Inverters is most suitable.

UNIT 3.5: Installation of PV system

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Install solar cable, plugs, spars fuse, solar panels and battery.

Resources to be Used

- Computer, projector, whiteboard, duster & marker.
- Stationary items like pen, pencil, colored markers, double-sided tape, scissor, blank A4 papers chart papers etc.
- Power point slides or videos on Installation of PV system.

Say

- This chapter deals with installation of PV system.
- We will be having practical learning of solar PV installation.

Elaborate

- Installation process which include:
  - ✓ Location identification for solar array
  - ✓ Solar array mounting pole
  - ✓ Solar array rack
  - ✓ Placing the solar modules on the rack
  - ✓ Connecting the solar panels
  - ✓ Electrical connections
  - ✓ Solar pump controller
  - ✓ Solar pump, batteries and invertors

Demonstrate

- Take the participants to nearby site for live demonstration of installation of PV system.
- Motivate the participants to observe the demonstration carefully.
- During demonstration, clarify all doubts of the participants.

Activity

Purpose : To install the PV system. Time may be plan for 30 min. or depends on the distance of location.

Methodology : Visit nearby site.

- Divide the class into 4-5 groups.
- Take the groups to nearby site.
- Ask the groups to install the PV system as per demonstrated way.
- Check if they have correctly installed PV system or not.
- Supervise and guide the groups to carry out the installation process.
- Appreciate the students actively participating in the activity.

Notes for Facilitation

- Demonstrate and describe installation of PV system.
- Arrange innovative videos on installation of PV system.
- Ensure more pictorial presentation of learning wherever possible in the classroom.
- Motivate the participants to work in groups so that they develop sense of team building skills.
- Ensure practical session wherever required.

Exercise

Key Solutions to PHB Exercises

1. The steps of solar system installation are:
   - Location identification for solar array
   - Solar array mounting pole
   - Solar array rack
   - Placing the solar modules on the rack
   - Connecting the solar panels
   - Electrical connections
   - Solar pump controller
   - Solar pump, batteries and invertors

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

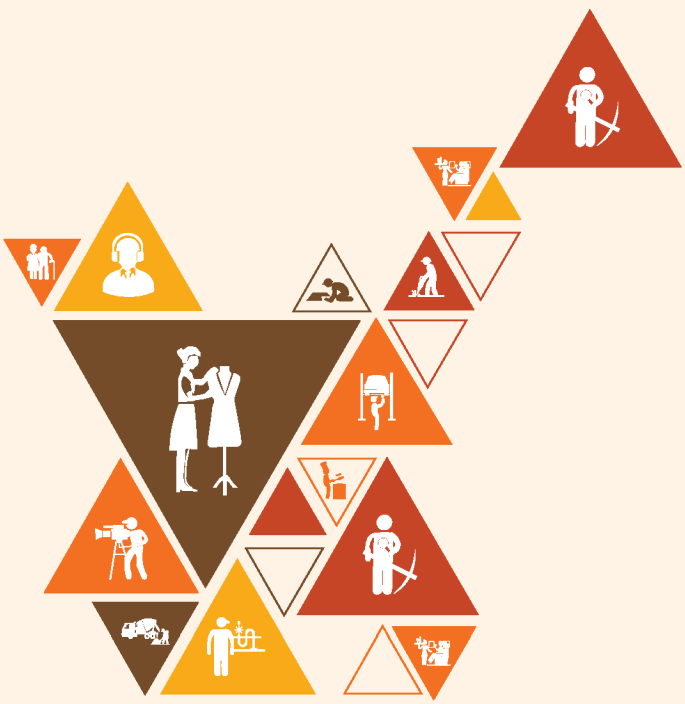
ASCI
Agriculture Skill Council of India

4. Installation of the Plumbing System and Water Pump

Unit 4.1 - Basics of Plumbing

Unit 4.2 - Pumps and Its Types

Unit 4.3 - Solar Pumping System and Installation



AGR/N6703

Key Learning Outcomes

After the completion of this module, the participant will be able to:

1. Describe the process of installing plumbing fittings and fixtures such as valves, clamps, elbows, sprinklers, taps, etc.
2. Explain different methods of cutting, bending and joining fittings and fixtures.
3. List various hand and power tools required for the installation of the plumbing system and solar pump.
4. Explain the importance of guiding the farmers on minor repair and maintenance of the solar pump and panels along with the applicable safety precautions.
5. Explain the benefits of resource optimisation.
6. Describe the methods of recycling and disposing of different types of waste.
7. Explain the importance of inclusion of all genders and Persons with Disability (PwD) at work.

UNIT 4.1: Basics of Plumbing

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain importance of plumbing.
2. Describe the process of installing plumbing fittings and fixtures.
3. Explain the techniques of cutting, bending and joining of pipes.
4. List various hand and power tools.

Resources to be Used

- Available objects such as a white board, duster, marker, notepad, pens, participant handbook, computer, projector, flip charts, practice paper etc.
- Power point slides or videos on plumbing.
- Pictures or illustrations on basic hand and power tools.
- Instruments and plumbing parts such as pump pipes, tubes, fittings for practical session.

Say

- Greet the participants and revise the key learnings of previous session discussion.

Elaborate

- Plumbing
- Basic plumbing fittings and fixtures
- Techniques of cutting, bending and joining pipes
- Basic hand and power tools
- Units of measurement in plumbing

Team Activity

Purpose: To know the uses of various hand & power tools.This activity may be planned for 15-20 minutes.

Methodology : Pen and paper activity

- Make 2-3 groups of participants. Display the basic hand and power tools and ask each group to identify and list the name of tools with their uses.
- Check if they have done right identification and understood their use.

Practical

- Do practical session with the participants. Teach them the techniques of cutting, bending and joining. Show them all kinds of joints and how to handle the same.
- Ask the participants to practice the techniques of cutting, bending and joining.
- Assist the participants in completing their tasks.
- Encourage the participants to ask questions.

Notes for Facilitation

- Assist all groups to understand the topic clearly through visualization.
- Focus on ensuring pictorial as well as live presentation for learning.
- Organize a field visit for live demonstration on plumbing.
- Involve the participants through group activities, discussions and learning by doing.

Exercise

Key Solutions to PHB Exercises

1. Four basic hand and power tools are:
   - Pliers: Plier is the tool used to hold the materials very tightly and firmly.
   - Screwdriver: Screwdriver is a tool used to tighten and loosen screws of various types used while joining and fixing.
   - Power drill: A power drill is an electric machine which rotates at high speed and is used to drill hole in the wall or metal or other hard materials.
   - Pipe cutter: It is a tool used by plumbers to cut pipe smoothly and evenly. It is a faster tool to cut pipes.

2. If you assemble the pipe to a branch pipe, you need to cut the pipes to required size. Firstly, it is suggested to try the assembling to check the size and fit and once the size is fine, do the soldering or welding. This will help you in ensuring that enough pipe is there inside each fitting, at least 1/2 inch, to make a seal. Pipe cutters are used to cut the copper pipe. Propane torch is used for soldering.

3. Refer to section 4.1.2-Basic plumbing fittings and fixtures

4. Soldering the metal pipe:
   - Clean the pipes thoroughly with sand paper to smoothen the surface both outside and inside the fittings.
   - Apply non-corrosive layer of paint on all the surfaces of pipe to prevent any rusting.
   - Apply this flux evenly on the surface and wipe the excess around the fitting.
   - Never allow the fluxed joint to stand for more than 3 hours before soldering.
   - Cool the pipe after soldering and do not move it again and again. It might damage or weaken the joint.
   - Always remember that soldering should be done on a dry and vapour free pipe as it might affect the melting point of the metal.

5. Pipe bender is used to bend angle of pipe. Threading tools are used to thread the pipes and crimping tools are used to connect pipes.

UNIT 4.2: Pumps and Its Types

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain the functioning of solar pumps and its types.

Resources to be Used

- Available objects such as a white board, duster, marker, notepad, pens, participant handbook, computer, projector, flip charts, etc.
- Power point slides, pictures / posters indicating function of solar pumps and its types.
- Video films describing the functioning of solar water pumps.

Ask

- What are different types of solar pumps?
- What could be the functions of solar water pumps?

Elaborate

- Types of solar pump
- Functioning of solar power pumps

Demonstrate

- Demonstrate the functioning of solar power pumps.
- Motivate the participants to observe the demonstration carefully.
- During demonstration clarify all doubts of the participants.

Activity

Purpose: To understand solar pumps and its functioning. This activity may be planned for 15-20 minutes.

Methodology : Question/Answer

- With the help of few videos show the students the types of solar pump and functioning of solar pumps.
- Motivate students to engage in the video.
- Conduct a question answer session at the end of the video session.

Say

- I hope you all enjoyed the video. It will help you to understand the topic better.

Notes for Facilitation

- Explain in detail the use of each type of pumps and the parameters to select the right pump.
- Arrange real photos or pictures from the internet to show it to participants. This will give a clear picture of the solar water pumps.
- Plan a visit to nearest farm to show them the functioning of solar pumps.
- Participants should be provided with practical exposure.

Exercise

Key Solutions to PHB Exercises

1. Refer to section 4.2.2-Functioning of Solar power pumps.
2. **Submersible solar pumps are** pumps that are installed deep into the ground and are submerged under water. These pumps can directly be to the PV modules output with DC current or to an AC output if direct current is not compatible. These pumps are installed into the ground submersed in the water at a distance based on the water level. The deeper the water level, more power is required to pump the water out. These are used when water supply is deeper than 10 meters under the ground level. Surface solar pumps are the pumps which are used when the water supply is available on the water surface or no deeper than 10 meters. These pumps are installed in water sources like ponds, pumps, rivers etc. Surface pumps can push water to great distances on ground and thus can be installed at some distance from the destination. These pumps are also easy to install.
3. **Pressure:** Pressure defines the force or the work done required by the pump and push water from the source and deliver to the destination. The deeper the water source, more pressure required to elevate water. Pressure is always calculated in pounds per square inch (psi). When water moves from low level to upper level it takes
   0.433 psi of pressure to move every foot upwards. At the same time when water flows down, it creates the same amount of pressure.

   Many a times, piping system of the solar pump from source to destinations goes through a lot of uneven terrain where water sometimes flows from lower surface area to higher and then back lower and then higher. In this case the pressure at each transitional direction changes and we need to take into account this factor.

   Flow: Flow is defined as the amount of water moved by the solar pump system in given time. Flow is calculated as gallons per minute (GPM). As the water level goes down, pump has to elevate water to much higher distance and as the height of pipe in the storage tank increases, pump has to transfer water at much higher heights. In both the cases more pressure will have to be applied than earlier. Now if do not increase the pressure of the pump and pump has same power as earlier, it means pump has to do more work to transfer water at high heights than compared to lower heights. This in this case, flow of water will decrease as it has to travel more height now. Thus, we can say that flow of water will decrease when pressure increases and vice versa.

UNIT 4.3: Solar Pumping System and Installation

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Explain solar water pumping, its principle and installation.
2. Describe various components of solar pumping system.
3. Guidance to farmers for minor repairs and maintenance.

Resources to be Used

- Available objects such as a white board, duster, marker, notepad, pens, participant handbook, computer, projector, videos, flip charts, etc.
- Power point slides on solar pumping system and installation.
- Graphs explaining solar water pumping principles.

Ask

- What are three variables on which capacity of pump depends?
- What are the different components of solar water system?

Elaborate

- Solar water pumping principles
- Main solar water system components and installation
- Step to design Solar powered pumping system
- Precautions while handling the mechanical products

Demonstrate

- Demonstrate the functioning of solar power pumps.
- Motivate the participants to observe the demonstration carefully.
- During demonstration clarify all doubts of the participants.

Practical

Objective : To impart hands on training on installation of pump

- Take the participants to nearby farm.
- Divide the participants into 4-5 groups.

- Ask the groups to take pump and practice installation of pump
- Check if the participants are performing as per demonstrated way or not.
- Supervise and guide the participants in completing the practical.
- **Practice Indicators:**
  - ✓ Connecting pump to other components
  - ✓ Electric connection in pump
  - ✓ Checking the power and pressure of pump
- At the end of practical, ask the participants if they have any queries.

Notes for Facilitation

- Arrange relevant reference material based on content in participant handbook.
- Encourage hands on experience through practical assignments.
- Focus on learning by doing.
- Ensure sufficient pictorial presentation for learning, arrange for visual aids, power point presentations, charts, flip charts, etc.

Exercise

Key Solutions to PHB Exercises

1. Generally, it is said that a 2 HP pump can cater to about two acres of land and a 7.5 HP is said to cater to 10 acres of land, but this data varies depending on the groundwater levels and the type of irrigation required for a particular crop.

2. The motor pump set for irrigation and domestic drinking water should have a capacity in the range of 0.1 HP to 5 HP. Although, municipal and rural community applications could choose a higher capacity solar pump. For a DC motor pump set, the discharge varies from 14 - 100 litres of water per watt peak of PV array while for AC motor pump, the discharge varies from 13 - 19 litre of water per watt peak of PV. The average discharge, however, depends on solar intensity, location, season and other factors.

3. Relocation of the solar pump system is not advisable. However, the system can be relocated using a mobile mounting platform but the process is expensive and may also cause damage to the system.

4. No. Lack of sunlight affects the working of solar water pumps. On such days, however, a hybrid power supply can be given to the pump. The pump can be connected to the state electricity grid or a diesel generator set after making proper adjustments in the controller. But such an arrangement should be made only after consulting the manufacturer of the solar water pump.

5. The system needs very minimal maintenance which includes cleaning of the panels on a regular basis. Cleaning maintains the efficiency of the panel without which the panel's surface gets reduced exposure to irradiation from the dust and dirt on it.
   In comparison to diesel pumps, solar water pumps have a significantly longer life expectancy and continue to produce electricity for even longer than 25 years.

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

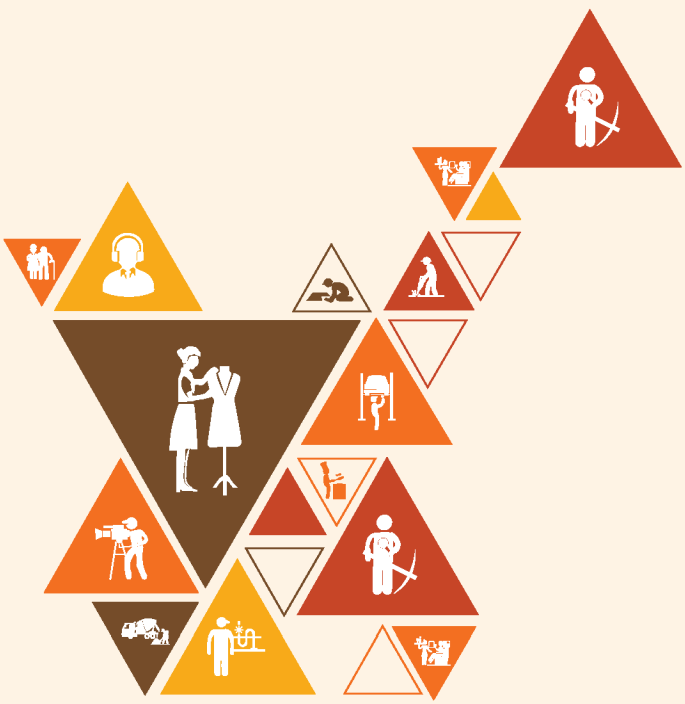
N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

5. Repair and Maintenance of Solar Pump Setup

Unit 5.1 - Maintenance and its Importance

Unit 5.2 - Monitoring Technical Issues and Repair of Solar Pump



AGR/N6705

Key Learning Outcomes

After the completion of this module, the participant will be able to:

1. Describe the use of relevant diagnostic, maintenance and repair tools and equipment.
2. Describe the process of examining the insulation of wires.
3. Explain various faults experienced with the electrical and plumbing systems in a solar pump setup.
4. Explain the importance of maintaining the record of maintenance activities.
5. Discuss the maintenance schedule for the solar pump and panels.

UNIT 5.1: Maintenance and its Importance

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Use of relevant maintenance and repair tools and equipment's.
2. Carry out maintenance of all the tools and equipment needed in the solar system.

Resources

- Available objects such as a participant handbook, pens, sticky notes, computer, projector, white board, duster, markers, flip charts, pen, notebook, laser pointer etc.
- Power point slides indicating maintenance of equipment and its importance.
- Instruments for demonstration

Ask

- Why do you think there is need to maintain equipment?
- What is the importance of maintenance of solar water pump?

Elaborate

- Maintenance and its importance
- Maintenance of instruments:
  - ✓ Module and arrays
  - ✓ Wiring and cables
  - ✓ Solar support structure
  - ✓ Inverter
  - ✓ Pump
  - ✓ Battery

Practical

- **Objective:** Maintenance of a stand-alone home lighting system for domestic house
- **Materials required:**
  - ✓ All safety gears
  - ✓ Equipment to handle electricity
  - ✓ Insulators
  - ✓ Wires
  - ✓ Testers
  - ✓ Load testers
  - ✓ Electrical kit

- **What to do**
  - Take the participants to nearby domestic house.
  - Demonstrate the participants how to do the maintenance of a stand-alone home lighting system for domestic house which is having the capacity of 1 kilowatt/day.
  - Ask the participants to practice on different loads i.e,
    - ✓ Fans
    - ✓ Tube Lights
    - ✓ T.V
- Find out the ratings of the system for 5 hours/day.
- Ask the participants to draw a neat sketch for AC system with storage for above mentioned loads.
- At the end of practical, solve participants' queries and explain them their responsibilities of instruments.

Notes for Facilitation

- Trainer must organize the visit to a farm to give demonstration and exposure to real situation of maintenance operations of Solar pump system.
- Enumerate frequencies of maintenance of instruments of solar pump system.
- Solar pump technician to demonstrate maintenance of instruments of solar pump system could be invited.
- Prearrange slides, pictures or videos specific to the topic.
- Constantly motivate each student to participate.

Exercise

Key Solutions to PHB Exercises

1. Use of operation & maintenance in SPV systems are:
   - Increases the shelf life of your equipment by significant amount.
   - Increases the capacity and efficiency of your system.
   - Delays the cost of purchasing of your next equipment.
   - Saves fuel and other resources due to less loss of energy in the well-maintained equipment.
   - Some instruments emit hazardous gases and waste when not maintained properly or when they become old.
   - Ensures the safety of equipment and from any dangerous incidence.
   - Timely fixes the issues like leakages, loss of power, part failure etc.

2. The tools required to maintain standalone systems are all safety gears, equipment to handle electricity, insulators, wires, testers, load testers, electrical kit.

3. Maintenance of a solar array are:
    - Check the conformity of the solar modules/arrays as per the specifications.
    - Compare the number of modules in the array with the design specified.
    - Check the inclination of the panel as per the season and output.
    - Ensure that no module is broken, twisted, scratched or cleaned.
    - Measure the voltage output from each string and ensure its consistent for all the modules.
    - To check the performance of PV module, check the short circuit current
    - Check the modules mounted are attached properly and all bolts are intact.
    - Ensure the mounting structure is not rusted including bolts.

4. Refer to section 5.1.2-Maintenance of Instruments
5. Checklist for battery maintenance are:
    - Check the battery terminals for corrosion and clear each part of it.
    - Fill the battery with distilled water only to prevent the contamination and do not overfill.
    - Battery capacity testing involves charging the battery fully and then give it time to discharge up to its limit i.e. depth of charge.
    - Periodically monitor if battery is working as expected in terms of power and charging time
    - Periodically (Y1-Y5) measure the capacity (AH) using a battery analyser to determine the battery health

UNIT 5.2: Monitoring Technical Issues and Repair of Solar Pump

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Troubleshoot and identify the issues and correct them.
2. Repair the instruments used in the solar system.

Resources

- Available objects such as a participant handbook, sticky notes, computer, projector, white board, duster, markers, flip charts, pen, notebook, laser pointer etc.
- Power point slides on troubleshooting various instruments in the solar system.
- Instruments for demonstration

Ask

- What is the meaning of troubleshooting? Why it is required.
- What are the different types of battery failure?

Elaborate

- Troubleshooting
  - ✓ Battery failure
  - ✓ Change controller failure
  - ✓ Common failures, PV modules, System browning, Common failures, Battery
  - ✓ Charge controller, Balance of systems (BOS)
  - ✓ Troubleshooting-overall system
- Maintaining log books

Practical

- **Objective:** Practice troubleshooting of solar panel components
- **Materials required**
  - ✓ Battery
  - ✓ AC system for troubleshooting
  - ✓ Safety gear
  - ✓ Chart
  - ✓ Pen

- **What to do**
  - ✓ Demonstrate and do troubleshooting for all the components learnt in this unit.
  - ✓ Divide the class into 4-5 groups to practice of troubleshooting on battery failures.
  - ✓ Also ask each group to do troubleshooting of AC system and regulated DC system with 3 loads each one and draw its figure manually.
  - ✓ Supervise and appreciate the team work and guide them in case of any anomalies.

Notes for Facilitation

- Arrange slides/charts or visuals on trouble shooting.
- Skill demonstration of troubleshooting on battery failures must be arranged
- Skill training on troubleshooting of AC system and regulated DC system may be provided.
- Describe various checkpoints need to be maintained in the log book.
- Encourage participants to have practical exposure on this topic.

Exercise

Key Solutions to PHB Exercises

1. The neglect or mission of expected or required action is known as failure. The common failures are batteries failures, inverters failures, charge controller failures, PV modules failures, etc.
2. Different types of battery failures are:
   - Easily discharged
   - Cannot be charged
   - Unequal cell voltages
3. Inverter Failure
   - As per one of the research studies of 90 water pumping systems investigated - 22 hardware failures (70% due to inverters) - Poor inverter design.

   Charge conNo current is flowing to the battery
   - Signals fully charged though battery is just being charged
   - Keeps charging troller unit (CCU) Failure:
   - even when fully charged
4. Refer to practical given in unit 5.2-monitoring the technical issues and repair of solar pump
5. Refer to section 5.2.1- troubleshooting
6. Refer to table 5.2.2-treoubishooting-checking charge controller

Notes

Skill India
कौशल भारत-कुशल भारत

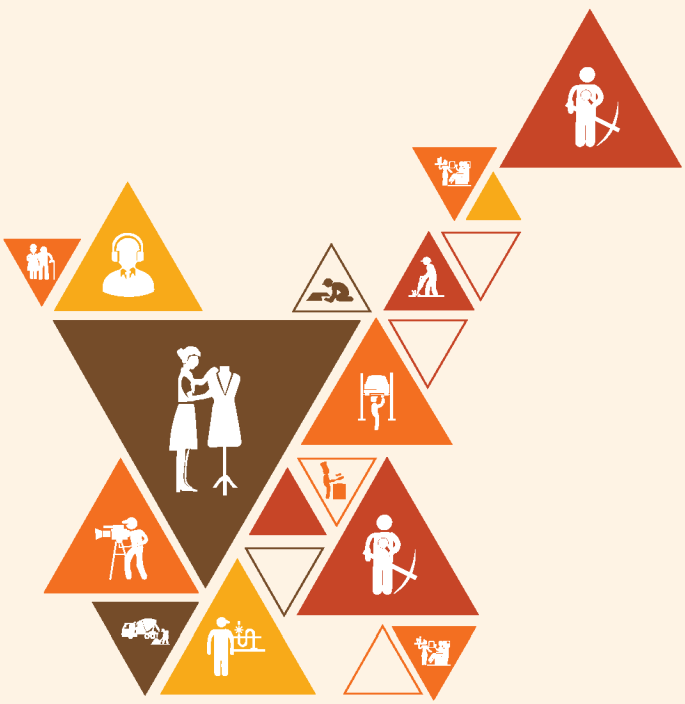
सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

6. Safety Procedures at Workplace

Unit 6.1 - Handling of Hazardous Waste
Unit 6.2 - Creation of Safe Working Environment



AGR/N9953

Key Learning Outcomes

After the completion of this module, the participant will be able to:

1. State safety and health policies to be followed at the workplace.
2. Explain the company's emergency evacuation procedure.
3. Describe how to handle hazardous material.
4. Describe how to operate hazardous tools and equipment.
5. Describe emergency procedures to be followed in case of emergencies.

UNIT 6.1: Handling of Hazardous Waste

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Discover about the hazardous waste.
2. Handle the hazardous waste material.

Resources

- White board, duster, marker, notepad, pens, participant handbook, computer, projector, charts, videos, power point slides describing hazardous waste of solar panels, illustration of recycling process etc.

Ask

- What harm does hazardous waste do to the environment?
- How can you manage hazardous waste from solar panels?

Elaborate

- Hazardous waste
- Waste management
- Disposal procedures of Solar panels
- Silicon based solar panel recycling
- Thin-film based solar panel recycling

Team Activity

Purpose: To understand about handling hazardous waste. This activity may be planned for 15-20 minutes.

Methodology : Group discussion & Q/A Session.

- Ask the students to divide themselves into 4-5 groups.
- Assign one topic to each team from below list and have peer group discussion on the learning.
  - ✓ Hazardous waste
  - ✓ Disposal procedures of Solar panels
  - ✓ Silicon based solar panel recycling
  - ✓ Thin-film based solar panel recycling
- Ask one of the team members from each team to discuss his/her topic and outcomes.
- Conduct question answer session after group discussion.
- Sum up the key outcomes from each discussion.
- Clear the doubts of the students.

Notes for Facilitation

- Provide in-house explanation of process of decomposing solar panels.
- Live demonstration of recycling of solar panels, if possible should be shown to the participants.
- Arrange slides, pictures or visuals for effective understanding of handling of hazardous waste.
- Relevant websites or you tube links may be shared for more detailed information on disposal process of solar panels

Exercise

Key Solutions to PHB Exercises

1. The harms hazardous waste do to environment are:
   - Waste from solar panels include metals which are poisonous like lead, copper, silver, cadmium, selenium. These metals if left in open grounds or dumped in water will cause heavy loss to the aquatic life and even the life on earth thus hampering the ecosystem.
   - Hazardous waste can pollute the air or get mixed in water to pollute it, if left unmanaged.
   - These PV modules are made of metals like silicon, semiconductors, glass etc. Which can be dangerous to public health if disposed in open.
2. We can recycle the PV cells up to 95%.
3. Refer to section 6.1.3- disposal procedures of solar panels and batteries.

UNIT 6.2: Creation of Safe Working Environment

Unit Objectives

After the completion of this unit, the participant will be able to:

1. Undertake the required safety measures while handling the various equipment.
2. Use first aid appropriately.

Resources

- Participant handbook, pens, paper, computer, projector, white board, marker, flip chart, PPT slides on creation of safe working environment, safety gears like safety glasses, helmets, foot gears, rubber gear, first aid kit (bandages, adhesive bandages, betadine solution / ointment, pain relief spray), etc.

Ask

- What is the importance of safety gears while carrying out installation?
- What is first aid? Why it is important?

Elaborate

- Importance of safety gears while carrying out installation
- Precautions while handling various equipment
- First aid kit and its usage
- Occupational health and safety standards (OHS)

Activity

Purpose: To prepare for undertaking various safety measures while installation. This activity may be planned for 15-20 minutes.

Methodology : Discussion

- Ask the participants to prepare checklist on precautions to be followed while handling various equipment.
- Randomly ask any one of the participants to discuss his/her checklist with the other learners.
- Facilitate the participants during discussion for desired learning outcomes.
- Sum up the session with positive outcomes.

Demonstrate

- First aid with the help of slides, charts, illustrations and some relevant videos under different field circumstances.
- Refer to the emergency procedures mentioned in this participant handbook

Role Play

- Ask for a role play amongst 2-3 participants to understand first aid/emergency procedures where one participant gets injured by tools and other participant would provide necessary first aid treatment to his fellow mate.
- Appreciate the efforts the students participating in the role play.

Notes for Facilitation

- Assist all groups to understand the topic clearly with active participation.
- Prepare a chart describing basic precautions while handing PV panel.
- Arrange for the material for demonstration whenever possible.
- Arrange to show a number of safety gears like safety glasses, helmets, foot gears, rubber gear, etc.
- Advice to participants to always use safety gears while installing solar PV system.

Exercise

Key Solutions to PHB Exercises

1. Precautions to be taken while installation of PV module:
   - Do not install near flammable gases.
   - Do not drill holes on glass surface of the modules.
   - The mounting structure and hardware must be made of durable, corrosion and uv-resistant material.
   - Each module or string must be connected with a fuse.

2. When the PV system catches fires, first of all try to extinguish fire with fire extinguisher,
   Immediately call the emergency number and report the higher authorities. In case any one is injured with burns then apply cool water and antiseptic and put bandage.

3. First aid kit, fire extinguisher, safety guards which includes clothes, shoes, gloves, goggles, appropriate instruments for carrying equipment, ladder to reach out easily to high altitude areas.

4. The steps followed during electric shock:
   - Shut off the electric supply from main power, or fuse
   - Immediately call the emergency help
   - Always work in pair
   - If you can't switch the power off, try to stand on dry area
   - Try to step on some wood material, rubber mat, plastic or other bad conductors of electricity.

Notes

Skill India
कौशल भारत-कुशल भारत

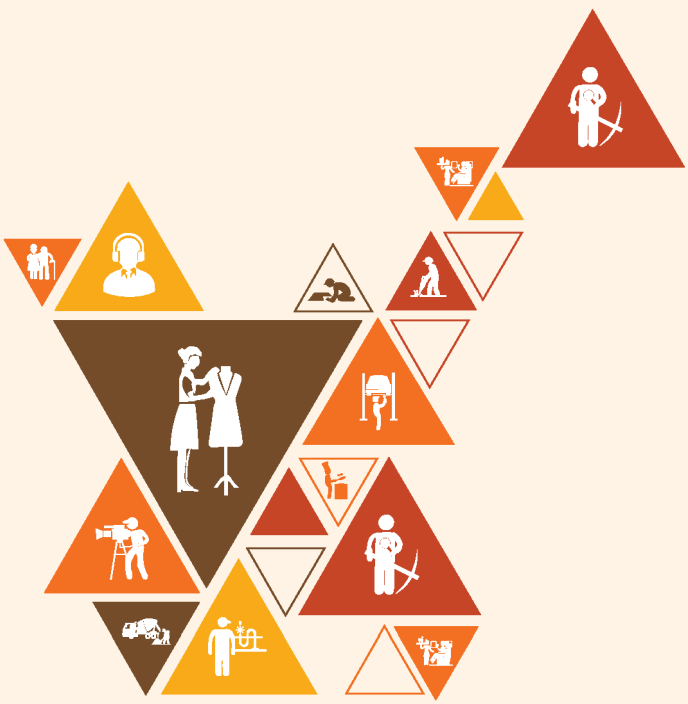
सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

6. Employability Skills (60 Hours)

To access content on Employability Skills, click here:
https://eskillindia.org/NewEmployability
Scan the QR code below to access the ebook



DGT/VSQ/N0102

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

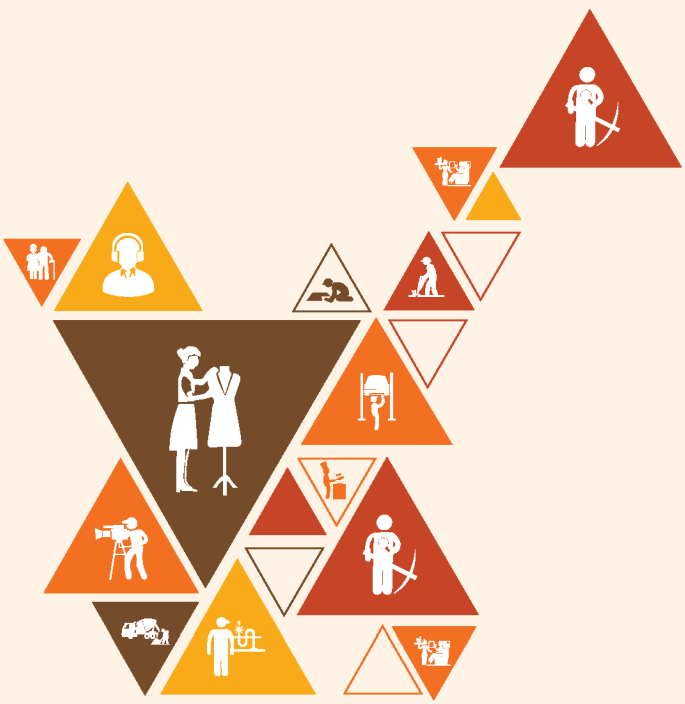
ASCI
Agriculture Skill Council of India

7. Annexures

Annexure I - Training Delivery Plan

Annexure II- Assessment Criteria

Annexure III- QR Codes –Video Links



Annexure I
Training Delivery Plan

Training Delivery Plan			
Program Name:	Solar Pump Technician		
Qualification Pack Name & Ref. ID	AGR/Q6701		
Version No.	**3.0**	**Version Update Date**	**17/11/2022**
Pre-requisites to Training (if any)	11th Class (Pass) OR 10th Class (Pass) with 2 Years of experience relevant experience OR 10th Class (Pass and pursuing continuous regular schooling) OR 8th Class with 4 Years of experience relevant experience OR Certificate-NSQF (Level-3 with minimum education as 5th grade pass) with 2 Years of experience relevant experience		
Training Outcomes	**After completing this programme, participants will be able to:** • Describe the process of conducting the site assessment and planning the solar pump installation. • Demonstrate the process of installing the solar panel, battery, plumbing system and pump. • Demonstrate the process of carrying out maintenance and repair of the solar pump. • Demonstrate various practices to maintain personal hygiene, cleanliness, and safety at the workplace. • Explain the importance of following the recommended inclusive practices for all genders and Persons with Disabilities (PwD).		

S. No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools/Aids	Duration
1	Introduction T: 5:00 (HH:MM)	1. Importance of Solar Pump in Agriculture-I	• Explain solar power industry in India and its Scope. • Explain the importance and benefits of Solar pump system in agriculture.		Classroom lecture, games,group activity,group partcipation	White board, duster, power point slides.	T: 2:00
		2. Importance of Solar Pump in Agriculture-II	• Discuss the role and responsibilities of a Solar Pump Technician. • Discuss various employment opportunities for a Solar Pump Technician.		Classroom lecture,group activity related to job role of solar pump technician,group participation	Power point slides on roles and responsibilities of a solar pump technician,charts, audio visual aid	T: 3:00

S. No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools/Aids	Duration
2	Process of Conducting Site Assessment and Planning the Solar Pump Installation T: 20:00 P: 35:00 (HH:MM)	1. Code of Conduct during Site Visit -I	• Demonstrate the business code of conduct to be followed during the site visit and customer dealing.	AGR/N6701 PC3, KU1, GS1-GS9	Classroom lecture, activity related to solar energy,exercise	Computer,projector, PPT slides on energy and its uses,pen,colored markers,chart papers,etc.	T: 2:00 P: 5:00
		2. Code of Conduct during Site Visit -II	• Communicate with farmers and co-workers and identify the frequency of visits and follow-ups	AGR/N6701 PC1, KU1, GS1-GS9	Classroom lecture, group discussion on energy and its types, group participation	White board,marker, computer,projector, PPT slides ,videos,pen,chart papers,etc.	T: 3:00 P: 5:00
		3. Energy, Its Uses and Sources	• Explain the various sources of energy. • Discuss the importance of solar energy and its extent in India.	AGR/N6701 PC5, KU6, GS1-GS9	Classroom lecture, demonstration, activity, practical on electrical circuit	Computer, projector, PPT slides, mutlimeter, battery, wires, resistor, etc.	T: 3:00 P: 5:00
		4. Basics of Electrical Circuit	• Define basic terminologies in electrical circuit. • Explain the various forms of current. • Demonstrate how circuit works.	AGR/N6701 PC6, KU6, GS1- GS9	Classroom lecture, demonstration, activity to list out bad & good conductors of electricity, practical on electrical instruments, exercise	PPT slides, chart, multimeter, voltmeter, wattmeter, diodes, capacitor, resistor, inductor,etc.	T: 3:00 P: 5:00
		5. Basics of Electronics	• Discuss about electronics. • Explain various components of electronics and their usage.	AGR/N6701 PC6, KU6, GS1-GS9	Classroom lecture, demonstration, expert session	Appropriate tools, PPT slides on site assessment,videos, pen, notebook,etc.	T: 3:00 P: 5:00
		6. Assessment of Site Installation-I	• Process of conducting site visit.	AGR/N6701 PC2, KU2, GS1-GS9	Field visit,group activity on site assessment, group participation	Appropriate tools, PPT slides on site assessment,videos, pen, notebook,etc	T: 3:00 P: 5:00
		7. Assessment of Site Installation-II	• Assess and identify the location of installation.	AGR/N6701 PC2, KU2, GS1- GS9	Classroom lecture, activity to list out materials required for solar panel, group participation	Computer, projector, whiteboard, markers, chart papers, PPT slides on Raw material procurement,etc.	T: 3:00 P: 5:00
3	Installation of the Solar Panel and Battery T: 30:00 P: 60:00 (HH:MM)	1. Working of Solar Photo Voltaic Cells and Panels -I	• Explain importance of photo voltaic cells.	AGR/N6702 PC2, PC3, KU5, GS1-GS7	Class room lecture, demonstration, facilitator led discussion, activity related to solar PV panels	PowerPoint slides or videos on Solar photo voltaic cells and panels, solar cell,etc.	T: 3:00 P: 5:00
		2. Working of Solar Photo Voltaic Cells and Panels -II	• Demonstrate the working of solar cells and panels	AGR/N6702 PC7, PC15, KU8, GS1-GS7	Class room lecture, demonstration, field visit to show the types of solar PV cells, group participation	Computer, projector, PPT slides, pen, chart, paper, etc.	T: 3:00 P: 5:00

S. No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools/Aids	Duration
		3. Mounting and Its Types-I	• Identify the types of mounting option for solar panels.	AGR/N6702 PC4, PC5, KU7, GS1-GS7	Class room lecture, demonstration, group activity on types of mounting, field visit	Computer, projector, whiteboard ,markers,pictures, chart paper,PPT slides on mounting & its types	T: 3:00 P: 5:00
		4. Mounting and Its Types-II	• Describe the process of mounting.	AGR/N6702 PC4, KU7, GS1-GS7	Classroom lecture, demonstration, facilitator led discussion, activity related to batteries	Computer, projector, whiteboard ,markers,pictures, chart paper,PPT slides on mounting & its types	T: 3:00 P: 5:00
		5. Batteries -I	• Explain batteries, types, their usage and working.	AGR/N6702 PC8-PC10, KU9, GS1-GS7	Classroom lecture, demonstration, field visit to show working of inverters,expert session	Computer, projector, whiteboard ,markers, PPTslides on battery and its types, batteries, invertors,etc.	T: 3:00 P: 5:00
		6. Batteries -II	• Connect the invertors in the solar panel system design	AGR/N6702 PC10, PC11, KU9, GS1-GS7	Classroom lecture, demonstration,group activity to install PV system, group partcipation	Computer, projector, whiteboard ,markers, PPTslides on battery and its types, batteries, invertors,etc.	T: 2:00 P: 6:00
		7. Inverters-I	• Explain Inverters, types, their usage and working.	AGR/N6702 PC10, PC11, KU9, GS1-GS7	Classroom lecture, demonstration, facilitator led discussion, activity related to batteries	Computer, projector, whiteboard ,markers, PPTslides on battery and its types, batteries, invertors,etc.	T: 3:00 P: 5:00
		8. Inverters-II	• Connect the invertors in the solar panel system design.	AGR/N6702 PC10, PC11, KU9, GS1-GS7	Classroom lecture, demonstration, facilitator led discussion, activity related to batteries	Power point slides, pen, paper, chart,colored markers,etc.	T: 2:00 P: 6:00
		9. Installation of PV System-I	• Install solar cable, plugs, spars fuse, solar panels and battery	AGR/N6702 PC7, KU8, GS1-GS7	Classroom lecture, demonstration, facilitator led discussion, activity related to batteries	Power point slides or videos on Installation of PV system,pen, paper, chart,colored markers,etc.	T: 3:00 P: 5:00
		10. Installation of PV System-II	• Practice installation of PV system	AGR/N6702 PC2, KU5, KU7, GS1-GS7	Classroom lecture, demonstration, facilitator led discussion, activity related to batteries	Power point slides or videos on Installation of PV system,etc.	T: 2:00 P: 6:00
		11. Recap	• Recapitulate complete module learning	AGR/N6702 PC1-PC5, KU1-KU, GS1-GS7	Classroom lecture, demonstration, facilitator led discussion, activity related to batteries	Power point slides, pen, paper, chart,colored markers,etc.	T: 3:00 P: 3:00
		12. Practical	• Recapitulate complete module learning	AGR/N6702 PC2, PC10, KU5, GS1-GS7	Practical, Activity	PV System, Batteries, Invertors, pen, paper, etc.	P: 4:00

S. No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools/Aids	Duration
4	Installation of the Plumbing system and water pump T: 30:00 P: 60:00 (HH:MM)	1. Basics Of Plumbing -I	• Explain importance of plumbing.	AGR/N6703 PC5, KU2, GS1-GS9	Classroom Lecture, demonstration,trainer led discussion, field visit to site	White board, marker, duster, computer projector, PPT slides, flip charts,etc.	T: 2:00 P: 5:00
		2. Basics Of Plumbing -II	• Describe the process of installing plumbing fittings and fixtures.	AGR/N6703 PC4, KU2, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	Computer,projector, PPT slides on farmer coordination,pen,notebook,etc.	T: 3:00 P: 5:00
		3. Basics Of Plumbing -III	• Explain the techniques of cutting, bending and joining of pipes.	AGR/N6703 PC2, KU3, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 2:00 P: 5:00
		4. Basics Of Plumbing -IV	• List various hand and power tools.	AGR/N6703 PC5, KU4, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 3:00 P: 5:00
		5. Pumps and Its Types-I	• Explain the functioning of solar pumps	AGR/N6703 PC9, KU9, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 2:00 P: 5:00
		6. Pumps and Its Types-II	• Explain the types of solar pumps	AGR/N6703 PC6, KU5, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 3:00 P: 5:00
		7. Solar Pumping System and Installation-I	• Explain solar water pumping, its principle and install it-I	AGR/N6703 PC8, KU7, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 2:00 P: 5:00
		8. Solar Pumping System and Installation-II	• Explain solar water pumping, its principle and install it-II	AGR/N6703 PC8, KU7, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 3:00 P: 5:00
		9. Solar Pumping System and Installation-III	• Describe various components of solar pumping system-I	AGR/N6703 PC12, GS1-GS9	Classroom lecture, demonstration, expert session, group participation	White board, marker, computer, projector, laser pointer, PPT slides, pen, notebook, flip charts etc.	T: 2:00 P: 5:00

S. No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools/Aids	Duration
		10. Solar Pumping System and Installation-IV	• Describe various components of solar pumping system-II	AGR/N6703 PC12, GS1-GS9	Class room lecture, facilitator led discussion, group activity	Computer, projector, PPT slides, sticky notes, flip charts, Instruments for demonstration,etc .	T: 3:00 P: 5:00
		11. Recap -I	• Recapitulate complete module learning -I	AGR/N6703 PC12, KU5, KU9, GS1-GS9	Class room lecture ,demonstration, practical, group participation	Computer, projector, PPT slides, sticky notes, flip charts, Instruments for demonstration,etc	T: 2:00 P: 5:00
		12. Recap -II	• Recapitulate complete module learning -II	AGR/N6703 PC12, KU5, GS1-GS9	Class room lecture, facilitator led discussion, Q/A session	White board, marker, duster, flip charts, pen, notebook,etc.	T: 3:00 P: 5:00
5	Repair and Maintenance of Solar Pump Setup T: 20:00 P: 40:00 (HH:MM)	1. Maintenance and Its Importance-I	• Use of relevant maintenance and repair tools and equipment's.	AGR/N6705 PC2, PC10, KU3, GS1-GS9	Classroom lecture, demonstration, expert session, group participation practical demonstration, field /farm	Computer, projector, pens, sticky notes, white board, duster, markers, PPT slides on maintenance of equipment and its importance, laser pointer etc.	T: 2:00 P: 5:00
		2. Maintenance and Its Importance-II	• Carry out maintenance of all the tools and equipment needed in the solar system-I	AGR/N6705 PC10, PC11, KU3, KU9, GS1-GS9	Classroom lecture, demonstration, expert session, group participation practical demonstration, field /farm	Computer, projector, pens, sticky notes, white board, duster, markers, PPT slides on maintenance of equipment and its importance, laser pointer etc.	T: 3:00 P: 5:00
		3. Maintenance and Its Importance-III	• Carry out maintenance of all the tools and equipment needed in the solar system-II	AGR/N6705 PC10, PC11, KU3, KU9, GS1-GS9	Classroom lecture, demonstration, expert session, group participation practical demonstration, field /farm	Computer, projector, pens, sticky notes, white board, duster, markers, PPT slides on maintenance of equipment and its importance, laser pointer etc.	T: 2:00 P: 5:00
		4. Monitoring Technical Issues and Repair of Solar Pump-I	• Troubleshoot and identify the issues and correct them-I	AGR/N6705 PC5-PC7, KU6, GS1-GS9	Class room lecture, facilitator led discussion, group activity	Computer, projector, PPT slides, sticky notes, flip charts, Instruments for demonstration,etc	T: 3:00 P: 5:00
		5. Monitoring Technical Issues and Repair of Solar Pump-II	• Troubleshoot and identify the issues and correct them-II	AGR/N6705 PC5-PC7, KU6, GS1-GS9	Class room lecture, facilitator led discussion, group activity	Computer, projector, PPT slides, sticky notes, flip charts, Instruments for demonstration,etc	T: 2:00 P: 5:00
		6. Monitoring Technical Issues and Repair of Solar Pump-III	• Repair the instruments used in the solar system.	AGR/N6705 PC10, KU3, GS1-GS9	Class room lecture, facilitator led discussion, group activity	Computer, projector, white board, duster, markers, PPT slides on troubleshooting various instruments in the solar system, laser pointer etc.	T: 3:00 P: 5:00

S. No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools/Aids	Duration
		7. Recap -I	• Recapitulate complete module learning -I	AGR/N6705 PC5-PC7, KU1-KU5, GS1-GS9	Class room lecture ,demonstration, practical, group participation	Computer, projector, PPT slides, sticky notes, flip charts, Instruments for demonstration,etc	T: 3:00 P: 5:00
		8. Recap-II	• Recapitulate complete module learning -II	AGR/N6705 PC5-PC7, KU1-KU5, GS1-GS9	Class room lecture, facilitator led discussion, Q/A session	Computer,projector, PPT slides on farmer coordination,pen, notebook,etc.	T: 2:00 P: 5:00
6	Safety Procedures at Workplace T: 15:00 P: 15:00 (HH:MM)	1. Handling of Hazardous Waste-I	• Discover about the hazardous waste.	AGR/N9953 PC2, KU6, GS1, GS2	Classroom lecture,group activity related to hazardous waste,group participation	Computer, projector, PPT slideson hazardous waste of solar panels, pen, notebook,etc.	T: 4:00 P: 3:00
		2. Handling of Hazardous Waste-II	• Handle the hazardous waste material.	AGR/N9953 PC2, KU6, GS1, GS2	Classroom lecture,group activity related to hazardous waste,group participation	Computer, projector, PPT slideson hazardous waste of solar panels, pen, notebook,etc.	T: 4:00 P: 4:00
		3. Creation of Safe Working Environment-I	• Undertake the required safety measures while handling the various equipment.	AGR/N9953 PC2, PC3, KU2, GS1, GS2	Classroom lecture, facilitator led discussion, group participation	Computer, projector, PPT slideson hazardous waste of solar panels, pen, notebook,etc.	T: 4:00 P: 4:00
		4. Creation of Safe Working Environment-II	• Use first aid appropriately.	AGR/N9953 PC13, KU8, GS1, GS2	Classroom lecture, facilitator led discussion, group participation	Computer, projector, PPT slideson hazardous waste of solar panels, pen, notebook,etc.	T: 3:00 P: 4:00

S.No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools / Aids	Duration HH:MM
7	Employability Skills (60hrs)	Introduction to Employability Skills	• Describe importance of Employability Skills • Prepare a note on different industries, trends, required skills	DGT/VSQ /N0102	Classroom lecture, Team Activity	White-Boardand d, Markers, Chart Paper and Sketch pens, LCD Projecto r	1:30
		Constitutional Values: Citizenship	• Detail the principles of constitution of India • Identify thevariousenvi ronmentallysus tainable practices		Classroom lecture, Team Activity	Laptop, PPT, White board Markers, note pad, pen etc.	1:30
		Becominga Professional inthe21st Century	• Discuss relevant 21stcentury skillsrequired foremployment • Practice criticalthinking anddecision makingskills		Classroom lecture, Team Activity	Laptop, PPT, White board Marers, note pad, pen etc.	2:30
		BasicSkills-I	• Read English textwith appropriateartic ulation • Practice basic English words, sentences, punctuation • Demonstrate active listening and reading skills		Classroom lecture, Team Activity, Role play, video session	Laptop, PPT, White board Markers, note pad, pen etc.	5:00
		BasicSkills-II			Practical, demonstration, role play		5:00
		Career Development and Goal Setting	• Identify well-defined short- and long-term goals • Explain how to build a career pathway Conduct job market research • Discuss how to set career goals.	DGT/VSQ /N0102	Class room lecture, discussion, demonstration, practical	Laptop, PPT, White board Markers, note pad, pen etc.	2:00

S.No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools / Aids	Duration HH:MM
		Communication Skills	• Explain the importance of communication at workplace • Demonstrate effective communication strategies • Demonstrate how to communicate effectively using verbal and nonverbal communication	DGT/VSQ /N0102	Class room lecture, discussion, demonstration, practical	Laptop, PPT, White board Markers, note pad, pen, audio visual aids etc.	5:00
		Diversity and Inclusion	• Explain the need of diversity at workplace • Identify the various PwD policies applicable at workplace • Discuss the significance of the POSH Act	DGT/VSQ /N0102	Class room lecture, Inter-active discussion	Laptop, PPT, White board Markers, note pad, pen, audio visual aids etc.	2:30
		Financial and Legal Literacy	• Discuss various financial institutions, products, and services • Explain the common components of salary such as Basic, PF, Allowances (HRA, TA, DA, etc.), tax deductions	DGT/VSQ /N0102	Class room lecture, demonstrations, group discussion, practical	Laptop, PPT, White board Markers, note pad, pen, audio visual aids etc.	5:00
		Essential Digital Skills-I	• Detail the use and features of various MS Office tools, like MS Word, MS Excel, MS PowerPoint, etc. • Demonstrate how to operate digital devices • Create an e-mail id and follow e- mail etiquette to exchange e -mails • Describe the role of digital technology in day-to-day life and the workplace	DGT/VSQ /N0102	Class room lecture, discussion, Demonstration, practical, learning by doing	Laptop, PPT, White board Markers, note pad, pen, audio visual aids etc.	6:00
		Essential Digital Skills-II	• Practice Digital skills		Demonstration, practical, learning by doing		4:00

S.No.	Module Name	Session Name	Session Objectives	NOS Reference	Methodology	Training Tools / Aids	Duration HH:MM
		Entrepreneurship	• Describe the types of entrepreneurship and enterprises • Describe the4Ps Of Marketing-Product,Price, Place and Promotion and Apply the mas Per requirement • Create a sample Business plan, For the selected business	DGT/VSQ /N0102	Class room lecture, discussion, Demonstration, practical	Laptop, PPT, White board Markers, note pad, pen, audio visual aids etc.	7:00
		Customer Service	• Identify types of customers and how to deal with them • Identify methods to get customer feedback and how to implement them • Explain various tools used to collect customer feedback • Discuss the significance of maintaining hygiene and dressing appropriately	DGT/VSQ /N0102	Class room lecture, activity, role play, video session	Laptop, PPT, White board Markers, note pad, pen, audio visual aids etc.	5:00
		Apprenticeships and Jobs	• Practice personal grooming strategies • Illustrate the use of online platforms for job hunting • Detail the concept of Apprenticeship • Demonstrate how to enroll for Apprenticeship programs. • Draft a professional Curriculum Vitae (CV) • Role play a mock interview	DGT/VSQ /N0102			8:00

Annexure II

Assessment Criteria

CRITERIA FOR ASSESSMENT OF TRAINEES

(For Updated 'Assessment Criteria', please refer to Qualification Pack of this Job role available at https://www.nqr.gov.in/)

Assessment Criteria for ASCI- Solar Pump Technician	
Job Role	**Solar Pump Technician**
Qualification Pack	**AGR/Q6701**
Sector Skill Council	**Agriculture**

S.No.	Guidelines for Assessment
1.	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2.	The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3.	Assessment will be conducted for all compulsory NOS, as well as the selected elective NOS/set of NOS.
4.	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below).
5.	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on this criteria.
6.	To pass the Qualification Pack , every trainee should score a minimum of 70% of aggregate marks to successfully clear the assessment.
7.	In case of *unsuccessful completion*, the trainee may seek reassessment on the Qualification Pack.

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
AGR/N6701.Conduct site assessment and plan the solar pump installation	30	40	-	30	100	25
AGR/N6702.Install solar panel and battery	30	40	-	30	100	25
AGR/N6703.Install plumbing system and pump	30	40	-	30	100	25
AGR/N6705.Carry out maintenance and repair of solar pump	30	40	-	30	100	15
ELE/N9953.Ensure safety at workplace	40	60	-	-	100	5
DGT/VSQ/N0102.Employability Skills (60 Hours)	20	30	-	-	50	5
Total	**180**	**250**	**-**	**120**	**550**	**100**

Annexure-III

QR Codes – Video Links

Chapter No.	Unit No.	Topic	QR Code Links	QR code (s)
Chapter -1 Introduction to the Role of a Solar Pump Technician	Unit 1.1 - Importance of Solar Pump in Agriculture	Introduction to Solar Pumps	https://www.youtube.com/watch?v=nLMPX93Rp90&list=PLG9ZH8glF2g2F3kCfbvDe8tRTB3CkeulB	Introduction to Solar Pumps
		Solar Water Pump for Agriculture	https://www.youtube.com/watch?v=5oPyU45a6v4	Solar Water Pump for Agriculture
		PM Solar Panel Subsidy | Kusum Yojana 2022	https://www.youtube.com/watch?v=INeRKyIjlWE	PM Solar Panel Subsidy
Chapter -2 Process of Conducting Site Assessment and Planning the Solar Pump Installation	Unit 2.3 - Basics of Electrical Circuit	Portable Solar Water Pump for Agriculture	https://www.youtube.com/watch?v=1UyipaJ0Ha8	Portable Solar Water Pump for Agriculture
		Solar Pump Installation Guide in Agriculture	https://www.youtube.com/watch?v=_nT4n4XkNZk&t=52s	Solar Pump Installation Guide in Agriculture
		Solar Pump - Types , Selection , Policy	https://www.youtube.com/watch?v=YDGoYUP37mo	Solar Pump - Types , Selection , Policy
		10 HP Solar Water Pump for Irrigation	https://www.youtube.com/watch?v=EJzgrRyJb2c	10 HP Solar Water Pump for Irrigation
Chapter -3 Installation of Solar Panel and Battery	Unit 3.1 to 3.5	Solar Components	https://www.youtube.com/watch?v=viCDZJ5NMFc	Solar Components
Chapter -4 Installation of the Plumbing System and Water Pump	Unit 4.1 to 4.3	Types of Solar Pumps	https://www.youtube.com/watch?v=7JRTV6qH85M	Types of Solar Pumps
		Best Practices in Solar Installation	https://www.youtube.com/watch?v=-FKSix1AS_Q	Best Practices in Solar Installation
		Setting Up Solar Pump: Controller, Wiring and Earthing	https://www.youtube.com/watch?v=yUl99lFHN30	Setting Up Solar Pump: Controller, Wiring and Earthing
		Learning how to Set up the Solar Pump Wiring and Plumbing	https://www.youtube.com/watch?v=FfTnVBA5v7s	Learning how to Set up the Solar Pump Wiring and Plumbing

Chapter No.	Unit No.	Topic	QR Code Links	QR code (s)
Chapter -5 Repair and Maintenance of Solar Pump Setup	Unit 5.1 - 5.2	Solar Pump Operation and Maintenance	https://www.youtube.com/watch?v=wvlpThHIRWQ	Solar Pump Operation and Maintenance

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N•S•D•C
National
Skill Development
Corporation
Transforming the skill landscape

Scan this QR to access eBook
https://eskillindia.org/Home/handbook/176

ASCI
Agriculture Skill Council of India

Address: 6th Floor ,GNG Buildin ,Plot No.10
Sector -44, Gurugram - 122004,Haryana, India
Email: info@asci-india.com
Web: www.asci-india.com
Phone: 0124-4288322, 4047488, 4046678
CIN No.: U93000HR2013NPL048073