Syllabus for Solar PV Systems Technician and Installer

Course Name	**Solar PV Systems Technician and Installer**
Sector	**Green Jobs**
Course Code	SGJ/2023/SPVI/227
Level	4
Occupation	Photovoltaic System Installer / Solar Panel Technician / Solar Installation Supervisor / Solar Sales Representative / Solar Energy Auditor.
Job Description	The Solar PV Systems Technician and Installer is a key player in the renewable energy sector responsible for various aspects of solar photovoltaic systems. This role involves assessing, installing, maintaining, and optimizing solar panels, ensuring their safe and efficient operation. Key responsibilities include evaluating system components, determining installation sites, managing battery systems, and educating stakeholders on mounting structures. The role requires a strong understanding of electrical systems, technical expertise in solar technology, and a commitment to safety and sustainability. This position contributes significantly to the growth of renewable energy and a greener future.
Course Duration	**Total Duration 540 Hrs (T-90, P-240, OJT-150, ES-60)**
Trainees' Entry Qualification	12th grade pass OR Completed 2nd year of 3-year diploma (after 10th) and pursuing regular diploma in Mechanical Engineering/Electrical Engineering/ Electronics & Telecommunication Engineering / Electrical & Electronics Engineering / Power Engineering OR 10th grade pass plus 2-year NTC in Electrician Trade / Electronics Mechanic Trade OR 10th grade pass and pursuing continuous schooling OR 10th Grade Pass with 2 yrs relevant field experience OR Previous relevant Qualification of Level 3.0 or equivalent with minimum education as 8th Grade pass
Trainers Qualification	BE/ B.Tech in Electrical/Electronics/ Electrical & Electronics Engineering / Power Engineering with 2 yrs relevant experience Or, Diploma in Electrical/Electronics/ Electrical and Electronics Engineering with 3 years of relevant industry experience Or, ITI in Electrician/Electronics Mechanic Trade with 5 years of relevant industry experience

Structure of Course:

Module No.	Module name	Outcome	Compulsory / Optional/ Elective	Theory (Hrs)	Practical (Hrs)	Total (Hrs) [Multiple of 30]
1	**Basic Electrical & Electronics**	Identify and test basic electrical and electronics circuit components and parameters along with use of measuring instruments.	Compulsory	20	40	60
2	**Solar Panel Systems and Photovoltaic Basics**	Identify solar panel systems, their components, and technical specifications, as well as calculating the required number of panels and connections for various loads	Compulsory	20	40	60
3	**Solar PV System Installation and Maintenance**	Perform site selection, Installation, maintenance, and safe operation of solar PV systems,	Compulsory	10	50	60
4	**Solar Panel Tilt Angle & Battery**	Set the tilt angle of solar panels for maximum efficiency and identify the characteristics of various solar battery types	Compulsory	20	40	60
5	**Mounting Structure**	Prepare a mounting structure for solar panel installations on a range of surfaces while ensuring structural integrity and efficient electrical connections.	Compulsory	10	50	60
6	**Work Safety & Procedure**	Apply health and safety practices at the workplace	Compulsory	10	20	30
7	**OJT**	Work in real job situation with special emphasis on basic safety and hazards in this domain.	Compulsory	--	150	150

Module No.	Module name	Outcome	Compulsory / Optional/ Elective	Theory (Hrs)	Practical (Hrs)	Total (Hrs) [Multiple of 30]
8	**Employability Skills**	As per guided curriculum	Compulsory	60	--	60
TOTAL:				150	390	540

SYLLABUS:

Module No. 1: Basic Electrical & Electronics Outcome:

Outcome: Identify and test basic electrical and electronics circuit components and parameters along with use of measuring instruments.

Theory Content:

1.1 Fundamentals of Electricity

- Definition of electric current, voltage, frequency, and power.
- Units of measurement for electric current (Amperes), voltage (Volts), frequency (Hertz), and power (Watts).

1.2 Basic Laws in Electrical Installations

- Explanation of Ohm's Law and its mathematical representation.
- Importance of Kirchhoff's Voltage Law (KVL) in analyzing voltage distribution in circuits.
- Importance of Kirchhoff's Current Law (KCL) in analyzing current flow in circuits.

1.3 Electrical Circuit Connections

- Differentiate between series and parallel electrical circuit connections.
- Analyze and solve problems involving combinations of series and parallel circuits.

1.4 Electrical Measurement Instruments

- Use and applications of common electrical measurement instruments:
    - Multimeter for measuring voltage, current, and resistance.
    - Clamp meter for measuring current in conductors without disconnecting them.

1.5 Components in Electrical and Electronic Circuits

- Overview and functions of key components:
    - Resistance, inductance, and capacitance.
    - Semiconductors: Transistors, Diodes, and MOSFETs.
    - Transformers and their applications.
    - Earth resistance measurement using a Megger.

Practical Content:

1.1 Electrical Parameter Measurement

- Practical use of instruments like Ammeter, Voltmeter, and Wattmeter for measuring electrical parameters.
- Hands-on exercises for measuring voltage, current, and power in circuits.

1.2 Soldering and Desoldering

- Hands-on soldering and desoldering practice to connect and disconnect components safely and securely.

1.3 Component Identification

- Identify and label components like resistors, inductors, capacitors, transistors, diodes, photo diodes, MOSFETs, and small transformers.

1.4 Earth Resistance Measurement

- Practical demonstration of using an Earth Megger to measure earth resistance in grounding systems.
- Interpretation of measurement results and assessment of safety

Tools & Equipment needed:

Multimeter, Clamp Meter, Soldering Iron, soldering pump, Soldering Station, Breadboard, Power Supply for circuit testing, Wire Stripper/Cutter, Needle-nose Pliers, Digital Oscilloscope (Optional), Earth Megger.

Components Kit: Includes resistors, capacitors, inductors, transistors, diodes, Photo diodes, MOSFETs, small transformers.

Electrical Wires: Assorted wires for connecting components and building circuits.

Solder: Lead-free solder for soldering practice.

Soldering Flux,

PCB (Printed Circuit Boards): For learners to practice soldering components onto boards.

Breadboard Wires: Jumper wires for connecting components on breadboards.

Whiteboard/Blackboard, Projector and Screen (Optional)

Module No. 2: Solar Panel Systems and Photovoltaic Basics

Outcome: Identify solar panel systems, their components, and technical specifications, as well as calculating the required number of panels and connections for various loads

Theory Content:

2.1 Introduction to solar panels and their role in converting sunlight into electricity.
2.2 Explain components of solar panel.
2.3 State and differentiate the types of solar cell, i.e. Monocrystalline or Polycrystalline.
2.4 Concept of Solar PV Module, Panel and Array.
2.5 Discuss about various size of a solar panel unit, i.e. 1.9 meter * 0.8 meter
2.6 Discuss about various power rating of a solar panel, i.e. 545W, 520W, 320W, 335W, 365W, 380W, 265W

2.7 Discuss about technical specification of a solar panel unit, i.e. Max Power, Operating Voltage and Current, Fill Factor, Open Circuit Voltage and Short Circuit Current.
2.8 Explain standard test condition (STC) and capacity utilization factor (CUF) in solar panel performance assessment.
2.9 State Nominal Operating Cell Temperature of a solar panel, i.e. 46 °C
2.10 Discuss the efficiency of SPV.
2.11 State which solar panel have higher efficiency, i.e. Monocrystalline or Polycrystalline.
2.12 Discuss the nature of load (AC or DC) connected to solar PV System.
2.13 Identify the load requirement of a household, i.e. 1kW, 5kW etc.
2.14 Determine how to distribute the load (simple house wiring diagram)

Practical Content:

2.1 Identify the SPV by observing the panel.
2.2 Hands-on calculation of the number of solar PV panels needed based on load requirements.
2.3 Calculate how many units should be connected in series for optimal performance
2.4 Calculate how many units should be connected in parallel to meet load requirements.

Tools & Equipment needed:

Actual solar panels of different sizes for a hands-on demonstration, Screwdrivers and other basic hand tools for disassembling a panel, Samples of monocrystalline and polycrystalline solar cells, posters illustrating modules, panels, and arrays, Load (AC/DC) simulator / demonstrating kits, Calculators, Multimeter, Temperature measuring equipment (e.g., infrared thermometer),

Module No. 3: Solar PV System Installation and Maintenance

Outcome: Perform site selection, Installation, maintenance, and safe operation of solar PV systems,

Theory Content:

3.1 Identify junction box, charge controller, battery, standalone inverter.
3.2 State block diagram of a solar PV system with
a) Solar unit
b) Junction box
c) Charge controller
d) Inverter
e) Household connection
3.3 Describe the function of electrical components: junction box, Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Moulded Case Circuit Breaker (MCCB
3.4 Explain type of maintenance, i.e. Preventive, Periodic, Regular maintenance for solar PV system.
3.5 Concept of Safety Walkaways, Safety Line, Edge Protection (handrails)
3.6 Earthing & Cables
- Selection of Cables & Wires [Size, Cable Material (Copper/Aluminium)]

- Techniques for Crimping of Lugs/Ties/Cable Glands/ MC4 Connector
- Earthing – for AC/DC system and Lightening Arrestor
- Power Evaluation & Connection

Practical Content:

3.1 Installation – Site Assessment, Panel Selection, Mounting Systems, Electrical Components, Permitting & Regulations, Installations Steps, Safety Protocols, and Testing & Commissioning
3.2 Use pyranometer to measure the amount of solar radiation (power) the sun produces in a specific location.
3.3 Demonstrate how to assemble solar units in series and parallel.
3.2 Assemble all units to a junction box through diode.
3.3 Connect the junction box to a charge controller.
3.4 Connect the charge controller to a battery.
3.5 Connect the battery to a standalone inverter.
3.6 Execute inverter to household connection.
3.7 Set up solar power plant up to 5 KW.
3.6 Practice Maintenance - Cleaning, Visual Inspection, Electrical checks, Shade Management, Battery maintenance, Remote Monitoring Systems, Warranty & Repair, and Safety Considerations.

Tools & Equipment needed:

1. Solar Panels, Mounting Systems, Junction Boxes, Charge Controllers, Batteries used in the solar PV system, Standalone Inverters, Miniature Circuit Breakers (MCBs), Earth Leakage Circuit Breakers (ELCBs), Moulded Case Circuit Breakers (MCCBs), Cable Crimping Tools, Multimeter, Site Assessment Tools (such as measuring tapes, compasses, and angle finders)

voltmeters, ammeters, and power analyzers, Pyranometer.

2. Cleaning Materials, Battery Maintenance Tools, Safety Walkways and Handrails, Electrical Wiring and Cables: Assorted cables, wires, and connectors for electrical connections. Projector and Screen:

Module No. 4: Solar Panel Tilt Angle & Battery

Outcome: Set the tilt angle of solar panels for maximum efficiency and identify the characteristics of various solar battery types

Theory Content:

4.1 Discuss in brief about tilt angle and its significance in solar panel orientation.
4.2 Explanation of the method for setting the optimal tilt angle for solar panels during the summer months.
4.3 Explanation of the method for adjusting the tilt angle for maximum efficiency during the winter season.
4.4 State about solar battery i.e. lead acid battery, Li-ion battery, SMF battery and their characteristics.

4.5 Explanation of battery capacity and its importance in determining energy storage
4.6 Description of battery types based on discharge rates, such as C-5, C-10, and C-20.
4.7 Explanation of battery parameters, including depth of discharge (DOD), state of charge (SOC), cycle life.
4.8 Explain specific gravity and its relevance for lead-acid battery

Practical Content:

4.1 Calculate and adjust the tilt angle of a solar panel in summer and winter, i.e. Latitude +/- 15
4.2 Hands-on demonstration of how to set the optimal tilt angle for solar panels during the summer season.
4.3 Practical exercises for adjusting the tilt angle of solar panels to maximize efficiency in winter
4.4 Hands-on activities to identify the capacity of solar batteries through visual inspection
4.5 Practical exercise to distinguish between different types of battery, i.e., C-5, C-10, C-20 by visual inspection.
4.6 Demonstration of how to use a hydrometer to measure specific gravity in lead-acid batteries

Tools & Equipment needed:

Solar Panel, Angle Measuring Tools such as protractors or inclinometers for measuring tilt angles accurately, Hydrometer, Solar Battery Samples C-5, C-10, C-20, Sample Batteries: lead-acid, Li-ion, SMF, Ammeter, Voltmeter, Digital Multimeter etc.

Module No. 5: Mounting Structure

Outcome: Prepare a mounting structure for solar panel installations on a range of surfaces while ensuring structural integrity and efficient electrical connections.

Theory Content:

5.1 Roof Mounted Structure

5.1.1: RCC Roof (Ballast Type)

Principles of ballast-type solar panel installation on RCC roofs.

Weight distribution and considerations for securing solar panels on RCC roofs.

5.1.2: Tin Shade (Flush Mounted)

Installation techniques for flush-mounted solar panels on tin shade roofs.

Fastening methods and materials for secure attachment.

5.1.3: Elevated Structure

Overview of elevated solar panel structures.

Structural requirements and considerations for elevated solar panel installations.

5.2 Ground Mounted (Fixed Tilt)

Principles and advantages of ground-mounted solar panel installations.

Techniques for securing solar panels on the ground with fixed tilt structures.

5.3 Fixing Fastener Bolts on the Roof Concrete

Step-by-step process for fixing fastener bolts on concrete roofs.

5.4 Fixing Base Plates of the Legs with Fastener Nuts

Detailed explanation of securing base plates of solar panel support legs with fastener nuts.

Ensuring stability and durability of the mounting structure.

5.5 Creating PCC Concrete Structures

Step-by-step instructions for creating PCC (Plain Cement Concrete) structures to cover fastener nuts.

Importance of proper sizing and leveling for a secure foundation.

5.6 Assembling Purlin and Rafter with Legs

Procedure for assembling purlin and rafter components with support legs.

Use of hexagonal nuts, bolts, and flat washers for secure connections.

Ensuring structural integrity and alignment of the solar panel system.

Practical Content:

5.1 Measure dimension of an MS iron angle

- Practical exercises in measuring the dimensions of an MS (Mild Steel) iron angle, including length, width, and thickness.

5.2 Measure dimension of a GI (Galvanized Iron) plate and bar

- Hands-on experience in measuring the dimensions of a GI plate and bar, including thickness, length, and width.

5.3 Identifying Fastener Components

- Recognizing different components of a fastener nut, including the nut itself, washers, and bolts.
- Understanding the purpose of each component in the fastening process.

5.4 Measuring Inner Diameter

- Practical exercises to measure the inner diameter of a hole accurately.
- Using appropriate tools and techniques for precise measurements.

5.5 Differentiating Galvanized MS Angle Iron

- Identifying and distinguishing between galvanized MS angle iron and non-galvanized MS angle iron.
- Recognizing the visual and structural differences.

5.6 Fixing a PV Module

- Hands-on practice in attaching a PV module to a mounting structure.
- Using nuts, bolts, and washers to securely fasten the PV module.
- Ensuring proper alignment and fastening techniques.

5.7 Roof Mounted Structure

- RCC Roof (Ballast Type)
    - Hands-on practice of installing solar panels on an RCC roof using ballast-type mounts.

    - Balancing and securing solar panels effectively.
- Tin Shade (Flush Mounted)
    - Practical installation of solar panels on tin shade roofs with flush-mounted systems.
    - Fastening and alignment techniques for secure attachment.
- Elevated Structure
    - Constructing elevated solar panel structures.
    - Hands-on experience with structural requirements and assembly.

5.8 Ground Mounted (Fixed Tilt)

- Implementation of ground-mounted solar panel installations with fixed tilt structures.
- Securing solar panels on the ground while optimizing tilt angle.

5.9 Roof Preparation

- Preparing the roof surface for solar panel installation.
- Cleaning and inspecting the roof for potential issues.

5.10 Fastener Bolts and Base Plates

- Hands-on practice in fixing fastener bolts on concrete roofs.
- Installing base plates for support legs with fastener nuts.

5.11 PCC Concrete Structures

- Practical application of creating PCC (Plain Cement Concrete) structures to cover fastener nuts.
- Proper sizing, leveling, and curing techniques.

5.12 Assembling Purlin and Rafter with Legs

- Hands-on assembly of purlin and rafter components with support legs.
- Using hexagonal nuts, bolts, and flat washers for secure connections.

5.13 Electrical Connections

- Wiring solar panels in series and parallel configurations.
- Connecting solar panels to inverters and electrical systems.

Tools & Equipment needed:

- Ballast blocks or weights
- Solar panel mounting brackets for Roof Mounted Structure (RCC Roof - Ballast Type)
- Wrenches and sockets, Screwdrivers and drill and concrete bits
- Solar panel mounting brackets suitable for tin shade
- Structural components (posts, beams, and connectors) for Elevated Structure
- Bolts, nuts, and washers
- Levelling tools
- Safety equipment (harnesses, helmets)
- Ground mounting system components (posts, frames)
- Concrete or ground anchors
- Concrete anchors or fastener bolts for roof mounting
- Base plates for roof mounting
- Fastener nuts and bolts for roof mounting
- Cement, sand, and aggregate for concrete mix for creating PCC Concrete Structures
- Shuttering materials (plywood, supports) for creating PCC Concrete Structures
- Trowels and floats for creating PCC Concrete Structures

- Purlin and rafter components
- Support legs
- Solar panel wires and connectors
- Inverters and associated components
- Electrical tools (wire strippers, crimping tools)
- Safety gear (insulated gloves, safety glasses)

Module No. 6: Safe Working Practices

Outcome: Work effectively at workplace following safe and ethical working practices and good customer relationship.

Theory Content:

6.1 State the importance of work ethics and workplace etiquette.
6.2 Study & discuss the common reasons for interpersonal conflict and ways of managing them effectively. And the importance of following organizational guidelines for dress code, time schedules, language usage and other behavioural aspects.
6.3 Explain the common workplace guidelines and legal requirements on non-disclosure and confidentiality of business-sensitive information.
6.4 Describe the concept of waste management and methods of disposing hazardous waste.
6.5 Explain various warning and safety signs & describe different ways of preventing accidents at the workplace.
6.6 Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials

Practical Content:

6.1 Develop a sample plan to achieve organisational goals and targets.
6.2 Role-play to demonstrate the use of professional language and behaviour that is respectful to all genders.
6.3 Apply organizational protocol on data confidentiality and sharing only with the authorized personnel.
6.4 Demonstrate the use of protective equipment suitable as per tasks and work conditions.
6.5 Prepare a report to inform the relevant authorities about any abnormal situation/behaviour of any equipment/system.
6.6 Demonstrate the steps to free a person from electrocution safely.
6.7 Demonstrate the application of defined emergency procedures such as raising alarm, moving injured people, etc.

Tools & Equipment needed:

Safety Shoes, Safety Helmet, Safety Gloves etc.

Module No. 7: OJT

Outcome: Work in real job situation with special emphasis on basic safety and hazards in this domain

Practical Content:

Assessor will check report prepared for this component of Practical training of the course and assess whether competency has been developed to work in the real job situation with special emphasis on basic safety and hazards in this domain. (The trainee is expected to undertake work in actual workplace under any supervisor / contractor for 150 Hrs.)

Module No. 9: Employability Skills (60 Hrs)

Introduction to Employability Skills **Duration: 1.5 Hours**

1. Discuss the Employability Skills required for jobs in various industries
2. List different learning and employability related GOI and private portals and their usage

Constitutional values - Citizenship **Duration: 1.5 Hours**

3. Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen
4. Show how to practice different environmentally sustainable practices.

Becoming a Professional in the 21st Century **Duration: 2.5 Hours**

5. Discuss importance of relevant 21st century skills.
6. Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn etc. in personal or professional life.
7. Describe the benefits of continuous learning.

Basic English Skills **Duration: 10 Hours**

8. Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone
9. Read and interpret text written in basic English
10. Write a short note/paragraph / letter/e -mail using basic English

Career Development & Goal Setting **Duration: 2 Hours**

11. Create a career development plan with well-defined short- and long-term goals

Communication Skills **Duration: 5 Hours**

12. Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette.
13. Explain the importance of active listening for effective communication
14. Discuss the significance of working collaboratively with others in a team

Diversity & Inclusion **Duration: 2.5 Hours**

15. Demonstrate how to behave, communicate, and conduct oneself appropriately with all genders and PwD
16. Discuss the significance of escalating sexual harassment issues as per POSH act.

Financial and Legal Literacy **Duration:5 Hours**

17. Outline the importance of selecting the right financial institution, product, and service
18. Demonstrate how to carry out offline and online financial transactions, safely and securely
19. List the common components of salary and compute income, expenditure, taxes, investments etc.

20. Discuss the legal rights, laws, and aids

Essential Digital Skills **Duration: 10 Hours**

21. Describe the role of digital technology in today's life
22. Demonstrate how to operate digital devices and use the associated applications and features, safely and securely
23. Discuss the significance of displaying responsible online behavior while browsing, using various social media platforms, e-mails, etc., safely and securely
24. Create sample word documents, excel sheets and presentations using basic features
25. utilize virtual collaboration tools to work effectively

Entrepreneurship **Duration: 7 Hours**

26. Explain the types of entrepreneurship and enterprises
27. Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal risks with its mitigation plan
28. Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per requirement
29. Create a sample business plan, for the selected business opportunity

Customer Service **Duration: 5 Hours**

30. Describe the significance of analyzing different types and needs of customers
31. Explain the significance of identifying customer needs and responding to them in a professional manner.
32. Discuss the significance of maintaining hygiene and dressing appropriately

Getting Ready for apprenticeship & Jobs **Duration: 8 Hours**

33. Create a professional Curriculum Vitae (CV)
34. Use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively
35. Discuss the significance of maintaining hygiene and confidence during an interview
36. Perform a mock interview
37. List the steps for searching and registering for apprenticeship opportunities

Learning Outcome – Assessment Criteria

Module No.	Outcome	Assessment Criteria
1	Identify and test basic electrical and electronics circuit components and parameters along with use of measuring instruments.	1. Define electric current, voltage, frequency, and power with units of measurement 2. Utilize instruments like Ammeter, Voltmeter, multimeter and Wattmeter practically to measure electrical parameters 3. Explain Ohm's Law and its mathematical representation in theoretical and practical contexts. 4. Explain Kirchhoff's Voltage Law (KVL) in analyzing voltage distribution in circuits and apply it effectively. 5. Explain Kirchhoff's Current Law (KCL) in analyzing current flow in circuits and demonstrate

Module No.	Outcome	Assessment Criteria
		its practical application. 6. Differentiate between series and parallel electrical circuit connections both theoretically and in practical scenarios. 7. Identify resistance, inductance, and capacitance, along with semiconductors such as transistors, diodes, and MOSFETs, as well as transformers and their applications. 8. Conduct practical demonstrations to measure earth resistance, interpret measurement results, and assess safety effectively.
2	Identify solar panel systems, their components, and technical specifications, as well as calculating the required number of panels and connections for various loads	1. Accurately identify the components of a solar panel, including key elements and their functions. 2. State the differences between Monocrystalline and Polycrystalline solar cells, outlining their unique characteristics and applications. 3. Define the concepts of Solar PV Module, Panel, and Array, demonstrating an understanding of their roles within a solar power system. 4. Identify various sizes of solar panel units, such as the dimensions 1.9 meters * 0.8 meters, and explain their significance in different applications. 5. Explain the meaning and significance of various power ratings of solar panels (e.g., 545W, 520W, etc.), demonstrating an understanding of how power output varies. 6. Discuss the technical specifications of a solar panel unit, including Max Power, Operating Voltage and Current, Fill Factor, Open Circuit Voltage, and Short Circuit Current, ensuring a clear understanding. 7. Explain the concepts of Standard Test Conditions (STC) and Capacity Utilization Factor (CUF) in assessing the performance of solar panels. 8. State the Nominal Operating Cell Temperature (NOCT) of a solar panel (e.g., 46°C) and understand its significance in real-world applications. 9. Explain the nature of the load connected to a solar PV System (AC or DC) and its relevance in system design. 10. Identify typical load requirements for a household, such as 1kW or 5kW, demonstrating an understanding of load assessment. 11. Determine how to distribute the load effectively, including creating a simple house wiring diagram to illustrate load allocation. 12. Conduct hands-on calculations to determine the number

Module No.	Outcome	Assessment Criteria
		of solar PV panels required based on specific load requirements accurately. 13. Calculate and implement the optimal number of units to be connected in series / prallel to meet load requirements effectively and safely.
3	Perform site selection, Installation, maintenance, and safe operation of solar PV systems,	1. State a block diagram of a solar PV system that includes: a) Solar unit b) Junction box c) Charge controller d) Inverter e) Household connection 2. Identify and describe the functions of electrical components, Miniature Circuit Breakers (MCB), Earth Leakage Circuit Breakers (ELCB), and Moulded Case Circuit Breakers (MCCB) 3. Describe the concepts of Safety Walkways, Safety Lines, and Edge Protection (handrails) in the context of solar PV system installations. 4. Select appropriate cables and wires, considering size and material (Copper/Aluminium), for different components of the solar PV system. 5. Perform site assessments, panel selections, and mounting system installations following industry standards. 6. Measure solar irradiation with the help of pyranometer 7. Demonstrate the ability to assemble solar units in both series and parallel configurations. 8. Assemble all units to a junction box through diodes, ensuring proper electrical connections. 9. Connect the junction box to a charge controller correctly. 10. Connect the charge controller to a battery, demonstrating proper wiring techniques. 11. Connect the battery to a standalone inverter accurately. 12. Execute the inverter to household connection with adherence to safety measures. 13. Set up a solar power plant up to 5 KW. 14. Practice maintenance activities, including cleaning, visual inspection, electrical checks, shade management, battery maintenance, and repair

Module No.	Outcome	Assessment Criteria
		procedures.
4	Set the tilt angle of solar panels for maximum efficiency and identify the characteristics of various solar battery types	1. Calculate and adjust the tilt angle of a solar panel for summer and winter conditions, adhering to the latitude +/- 15° recommendation. 2. Demonstrate the practical procedure for setting the optimal tilt angle for solar panels during the summer season as well as during winter season. 3. Identify and state the characteristics of different solar battery types, including lead-acid batteries, Li-ion batteries, and SMF (Sealed Maintenance-Free) batteries. 4. Demonstrate the ability to distinguish between different battery types based on discharge rates (e.g., C-5, C-10, C-20) through visual inspection and state their significance. 5. Explain key battery parameters, including depth of discharge (DOD), state of charge (SOC), and cycle life, demonstrating understanding of their relevance. 6. Explain specific gravity and its relevance for lead-acid batteries in terms of electrolyte concentration. 7. Utilize a hydrometer to measure the specific gravity in lead-acid batteries, ensuring accuracy and proper understanding of the measurement.
5	Prepare a mounting structure for solar panel installations on a range of surfaces while ensuring structural integrity and efficient electrical connections.	1. Install solar panels on an RCC roof using ballast-type mounts considering weight distribution and ensuring effective balance. 2. Perform practical installation of solar panels on tin shade roofs with flush-mounted systems applying appropriate fastening and alignment techniques for secure attachment. 3. Outline structural requirements and considerations for elevated solar panel installations. 4. Construct elevated solar panel structures. 5. Implement ground-mounted solar panel installations with fixed tilt structures. 6. Execute the step-by-step process for securing fastener bolts on concrete roofs while effectively installing base plates for support legs

Module No.	Outcome	Assessment Criteria
		7. Apply practical techniques for creating PCC (Plain Cement Concrete) structures to cover fastener nuts; ensuring proper sizing, levelling, and curing techniques. 8. Assemble purlin and rafter components with support legs; utilizing hexagonal nuts, bolts, and flat washers for secure connections, maintaining structural integrity and alignment. 9. Identify and distinguish between galvanized MS angle iron and non-galvanized MS angle iron. 10. Demonstrate hands-on experience in measuring the dimensions of an MS (Mild Steel) iron angle and those of a GI (Galvanized Iron) plate and bar. 11. Demonstrate hands-on practice in attaching and fixing a PV module to a mounting structure ensuring proper alignment and fastening techniques. 12. Secure solar panels on the ground while optimizing tilt angle. 13. Wire solar panels in series and parallel configurations. 14. Connect solar panels to inverters and electrical systems, ensuring correct and safe connections.
6	Apply health and safety practices at the workplace	1. Explain the importance of work ethics and workplace etiquette. 2. Describe the common reasons for interpersonal conflict and way to manage them. 3. Follow the common workplace guidelines and legal requirements on non-disclosure and confidentiality of business sensitive information. 4. Describe the concept of waste management and methods of disposing hazardous waste. 5. Develop a sample plan to achieve organisational goal. 6. Apply safe working practices. 7. Demonstrate the uses of PPE 8. Demonstrate the procedure for emergency situation viz. electrocution etc and application of raising alarm, moving injured people etc.
7	OJT	Assessor will check report prepared for this component of Practical training of the course and assess whether competency has been developed to work in the real job

Module No.	Outcome	Assessment Criteria
		situation with special emphasis on basic safety and hazards in this domain. (The trainee is expected to undertake work in actual workplace under any supervisor / contractor for 150 Hours.)
8	Employability Skills	As per guided curriculum

List of Tools, Equipment & materials needed for 30 Trainees (Practical)

Sl. No.	Items Name	Specification	Qty
1	Cement, sand, and aggregate for concrete mix, Shuttering materials (plywood, supports), Trowels and floats for creating PCC Concrete Structures	Standard	As Required
2	Mechanical Fixtures Required For Panel Installation for Roof Mounted structure	Standard	As Required
3	Purlin and rafter components,Support legs	Standard	As Required
4	Solar panel mounting brackets suitable for tin shade	Standard	As Required
5	Structural components (posts, beams, and connectors) for Elevated Structure and Ground Mounting system with Bolts, nuts, and washers	Standard	As Required
6	Charge Controller	Standard	2
7	Load (AC/DC)	Standard	1 set
8	Miniature Circuit Breakers (MCBs), Earth Leakage Circuit Breakers (ELCBs), Moulded Case Circuit Breakers (MCCBs)	Standard	2 each
9	Regulated Power Supply	Standard	5
10	Sample Batteries: lead-acid, Li-ion, SMF	Standard	1 each
11	Samples of monocrystalline and polycrystalline solar cells	Standard	As required
12	Solar Battery Samples C-5, C-10, C-20	Standard	1 each
13	Solar Inverter (Ongrid/ Offgrid/ Hybrid)	Standard	1
14	Solar Panels of different sizes	Standard	As required
15	Ammeter	Standard	5
16	Digital Multimeter	Standard	5
17	Hydrometer	Standard	2
18	Infra red thermometer	Standard	1
19	Magnetic Compass	Standard	1
20	Measuring Tape	Standard	1
21	Megger	Standard	1
22	Voltmeter	Standard	5

23	Wattmeter	Standard	3
24	Pyranometer	Standard	1
25	Adjustable Wrench	Standard	5
26	AJB, ACDB, DCDB	Standard	1
27	Allen Key Set	Standard	5
28	Bread board with jumper wires	Standard	25
29	Cable Ties	Standard	2
30	Chain Pulling	Standard	1
31	Clamp Meter	Standard	1
32	Clamping Tools	Standard	1
33	Components: resistors, capacitors, inductors, transistors, diodes, Photo diodes, MOSFETs, small transformers.	Sample set	10 sets each
34	Connecting Wires	Standard	50
35	Cutter	Standard	1
36	Double Test Lamp	Standard	1
37	Drill Machine (with different size of bits)	Standard	2
38	Dull Wrench	Standard	1
39	Extension Chord	Standard	5
40	Flat File Tool	Standard	1
41	Grinder	Standard	1
42	Hacksaw with Blade	Standard	1
43	Hammer	Standard	1
44	Handrails	Standard	1
45	Lead Solder	Standard	2
46	MC4 Connector Clamping Tool	Standard	1
47	MC4 Connectors	Standard	2
48	MC4 Connectors Opener	Standard	1
49	Neon Tester	Standard	1
50	Nose plier	Standard	5
51	Pan	Standard	1
52	Pipe Wrench	Standard	1
53	Plier	Standard	5
54	PVC Tape	Standard	1
55	Safety Gloves	Standard	5
56	Safety Helmet	Standard	5
57	Safety Shoes	Standard	5
58	Screw Driver Set	Standard	5
59	Shovel	Standard	1
60	Solar Chart	Standard	5
61	Soldering Flux	Standard	2
62	Soldering Iron	Standard	10
63	Soldering pump for desolder	Standard	5
64	Triangular Scraper	Standard	1
65	Wire Stripper	Standard	5

Marks Distribution

Outcome	Outcome Code	Total Th Marks	Total Pr. Marks
Identify and test basic electrical and electronics circuit components and parameters along with use of measuring instruments.	SGJ/1405/OC1	30	80
Identify solar panel systems, their components, and technical specifications, as well as calculating the required number of panels and connections for various loads	SGJ/1405/OC2	30	80
Perform site selection, Installation, maintenance, and safe operation of solar PV systems,	SGJ/1405/OC3	20	100
Set the tilt angle of solar panels for maximum efficiency and identify the characteristics of various solar battery types	SGJ/1405/OC4	30	80
Prepare a mounting structure for solar panel installations on a range of surfaces while ensuring structural integrity and efficient electrical connections.	SGJ/1405/OC5	20	100
Apply health and safety practices at the workplace	SGJ/1405/OC6	20	60
Work in real job situation with special emphasis on basic safety and hazards in this domain (OJT).	SGJ/1405/OC7	0	300
Employability Skill-60 Hrs	DGT/VSQ/N0102	50	0