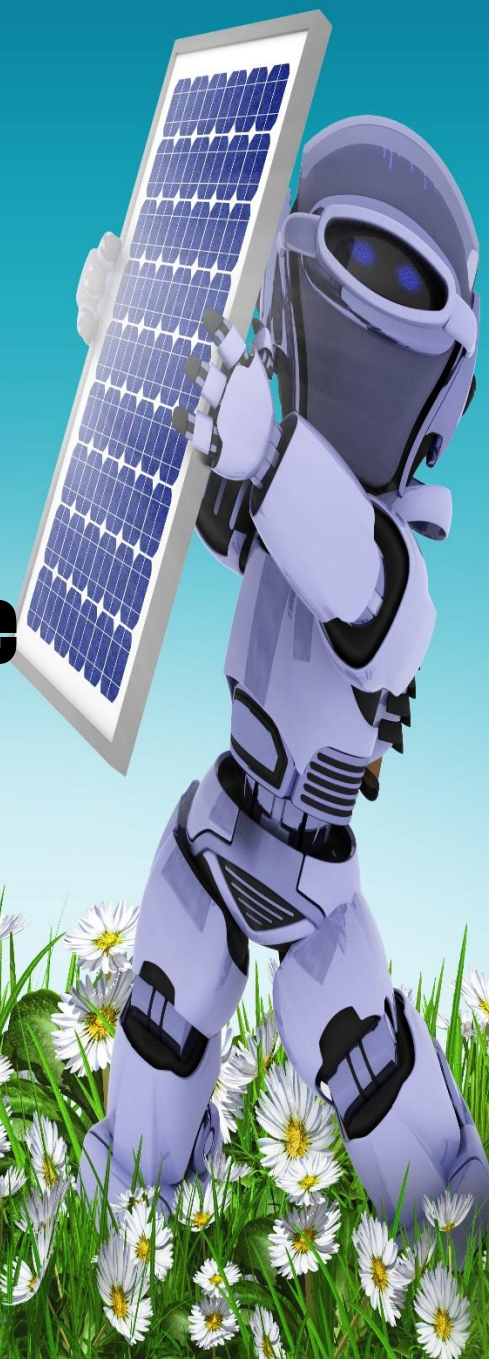




Certificate Course

Installation of Solar PV System and Maintenance



PSS Central Institute of Vocational Education

A Constituent Unit of National Council of Educational Research and Training (NCERT),

Ministry of Education (MoE), Government of India

Shyamla Hills, Bhopal – 462002, Madhya Pradesh, INDIA

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CERTIFICATE COURSE ON INSTALLATION OF SOLAR PV SYSTEM AND MAINTENANCE



FOREWORD

The National Education Policy (NEP) 2020 emphasises the integration of vocational education into mainstream learning to enhance employability and meet the growing demands of emerging sectors. In alignment with this vision, the PSS Central Institute of Vocational Education (PSSCIVE), Bhopal, has been taking consistent initiatives in developing competency-based curriculum, training modules, and certificate courses for learners and vocational trainers.

The present Certificate Course on Solar PV System Installer and Maintenance has been developed to prepare skilled manpower in the renewable energy sector. This course aims to equip learners with technical knowledge, hands-on competencies, and practical skills required for the installation, operation, and maintenance of solar photovoltaic (PV) systems. It also highlights industry practices, safety procedures, and sustainability aspects, thereby bridging the gap between theoretical knowledge and practical application.

I appreciate the efforts of the Department of Engineering and Technology, PSSCIVE, and the team of experts and resource persons who contributed their valuable knowledge and expertise in designing this course. Their dedication has ensured that the content is relevant, practical, and aligned with the industry requirements.

This initiative will contribute to creating a workforce capable of supporting India's renewable energy transition and achieving the national vision of clean and sustainable energy. I am confident that this course will benefit students, trainers, and institutions in strengthening vocational education and skill development.

We look forward to the cooperation and support of all stakeholders in making this initiative a success and in advancing vocational education for nation-building.

Dr. Deepak Paliwal

Joint Director
PSSCIVE, Bhopal
August 2025



PREFACE

The paradigm shift in Indian education envisioned by the National Education Policy 2020 (NEP 2020) underscores the importance of integrating vocational education, competency-based learning, and practical exposure to prepare learners for future job markets. In line with this vision, the PSS Central Institute of Vocational Education (PSSCIVE), Bhopal, has undertaken the development of a Certificate Course on Solar PV System Installer and Maintenance.

This course has been designed to equip learners with comprehensive knowledge and practical skills in the field of renewable energy, particularly focusing on the installation, operation, and maintenance of solar photovoltaic (PV) systems. It introduces students to the fundamentals of solar energy, system components, site assessment, installation procedures, safety practices, troubleshooting, and preventive maintenance. The curriculum is aligned with the National Skills Qualifications Framework (NSQF) to ensure relevance with industry standards and employability.

The course has been structured to promote experiential learning through hands-on activities, demonstrations, case studies, and problem-solving exercises. It not only aims to develop technical competencies but also nurtures an understanding of sustainable practices, thereby preparing a workforce capable of contributing to India's transition towards clean and green energy.

We express our sincere gratitude to the Ministry of Education, NCERT, industry experts, and all stakeholders for their valuable support and collaboration in developing this course. Their contributions have enriched the curriculum with practical insights and industry-oriented perspectives.

It is our firm belief that this certificate course will serve as a stepping stone for learners aspiring to build careers in the renewable energy sector, while also supporting India's larger mission of energy security and sustainability.

Dr. Saurabh Prakash

Head and Professor

Department of Engineering & Technology

PSSCIVE, Bhopal



ACKNOWLEDGEMENT

The PSS Central Institute of Vocational Education (PSSCIVE), Bhopal, expresses its sincere gratitude to all individuals and institutions whose valuable contributions and dedicated efforts have made possible the development of the Certificate Course on Solar PV System Installer and Maintenance. We extend our appreciation to the Ministry of Education (MoE), Government of India, and the National Council of Educational Research and Training (NCERT) for their constant support and guidance.

We extend our heartfelt thanks to the Director, NCERT, for his constant support and guidance. We also acknowledge the contributions of our colleagues at the National Council of Educational Research and Training (NCERT), National Skill Development Corporation (NSDC), Automotive Skill Development Council (ASDC), and the Sector Skill Council for Management and Entrepreneurship and Professional Skills for their academic support and cooperation in the development of the qualification file and curriculum.

We are especially grateful to Prof. Saurabh Prakash, Course Coordinator, for his untiring efforts and significant contribution to the development of this learning outcome-based curriculum. We sincerely acknowledge the contribution of Mr. Ankit Singh Chauhan (Assistant Professor) for valuable suggestions and editorial support in composing the material.

We are deeply thankful to the subject experts, industry professionals, and resource persons who shared their expertise in shaping the content of this course and ensuring its alignment with industry requirements and the National Skills Qualifications Framework (NSQF).

This collective effort reflects our shared vision of strengthening vocational education and equipping learners with the skills necessary to contribute to India's renewable energy future.

PSSCIVE
August 2025



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Certificate Course on Solar PV System Installer and Maintenance



1. Introduction

Solar energy has emerged as one of the most promising solutions to meet the world's growing energy demands while ensuring environmental sustainability. As India advances towards achieving its renewable energy goals, the demand for skilled professionals in the installation and maintenance of solar photovoltaic (PV) systems is steadily increasing.

The Certificate Course on Solar PV System Installer and Maintenance has been developed to prepare learners with the knowledge and hands-on skills required to work in this fast-growing sector. The course introduces the fundamentals of solar energy, PV system components, site assessment, installation techniques, safety procedures, troubleshooting, and preventive maintenance practices.

This course is aligned with the National Skills Qualifications Framework (NSQF) and designed to provide industry-relevant competencies. Through practical training, demonstrations, and case-based learning, students gain real-world exposure to solar PV technology, bridging the gap between classroom instruction and workplace requirements.

The skills developed through this course will enable learners to take up employment opportunities in the renewable energy industry, contribute to India's clean energy mission, and support the global transition towards sustainable energy systems.



2. Course Overview

This comprehensive program covers all essential aspects of solar photovoltaic (PV) systems from basic concepts of solar energy and system components to installation practices, safety measures, troubleshooting, and maintenance. By the end of the course, participants will be able to install, operate, and maintain solar PV systems with confidence, ensuring their efficiency and reliability. The course prepares learners to deliver high-quality, industry-ready services, thereby contributing to India's growing renewable energy sector and supporting the nation's transition towards a sustainable future.



3. Objectives

- To impart fundamental knowledge of solar energy and photovoltaic technology by providing in-depth training and certification in Solar PV System Installation and Maintenance.
- To familiarize learners with the tools, equipment, components, and safety practices used in the installation, servicing, and maintenance of solar PV systems.
- To develop practical skills in site assessment, system installation, wiring, testing, troubleshooting, and preventive maintenance, while creating pathways for continuous education and upskilling in the renewable energy sector.
- To prepare learners for employment opportunities in the rapidly growing renewable energy industry, where the global demand for skilled technicians in solar PV systems offers careers in companies, service enterprises, and large-scale projects in India and abroad.
- To build entrepreneurial abilities by equipping learners with industry-relevant knowledge and hands-on expertise, enabling them to explore opportunities in self-employment, start-ups, and small-scale solar enterprises.
- To encourage innovation in solar PV applications and promote the adoption of clean and sustainable energy practices for modern infrastructure and rural as well as urban contexts.
- To support sustainable livelihoods by empowering learners through vocational education and skill development, contributing directly to India's clean energy mission and global sustainability goals.

4. Teaching/Training Activities

The teaching and training activities have to be conducted in classroom, laboratory/ workshops and field visits. Students should be taken to field visits for interaction with experts and to expose them to the various tools, equipment, materials, procedures and operations in the workplace. Special emphasis should be laid on the occupational safety, health and hygiene during the training and field visits.

4.1 CLASSROOM ACTIVITIES

Classroom activities are an integral part of this course and interactive lecture sessions, followed by discussions should be conducted by trained vocational teachers. Vocational teachers should make effective use of a variety of instructional or teaching aids, such as audio-video materials, colour slides, charts, diagrams, models, exhibits, hand-outs, online teaching materials, etc. to transmit knowledge and impart training to the students.

4.2 PRACTICAL WORK IN LABORATORY/WORKSHOP

Practical work may include but not limited to hands-on-training, simulated training, role play, case-based studies, exercises, etc. Equipment and supplies should be provided to enhance hands-on learning experience of students. Only trained personnel should teach specialised



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techniques. A training plan that reflects tools, equipment, materials, skills and activities to be performed by the students should be submitted by the vocational teacher to the Head of the Institution.

4.3 FIELD VISITS/ EDUCATIONAL TOUR

In field visits, children will go outside the classroom to obtain specific information from experts or to make observations of the activities. A checklist of observations to be made by the students during the field visits should be developed by the Vocational Teachers for systematic collection of information by the students on the various aspects. Principals and Teachers should identify the different opportunities for field visits within a short distance from the school and make necessary arrangements for the visits.

5. Assessment and Certification

Upon successful completion of the course by the candidate, the Central/ State Examination Board for Secondary Education and the respective Sector Skill Council will certify the competencies. The National Skills Qualifications Framework (NSQF) is based on outcomes referenced to the National Occupation Standards (NOSs), rather than inputs. The NSQF level descriptors, which are the learning outcomes for each level, include the process, professional knowledge, professional skills, core skills and responsibility. The assessment is to be undertaken to verify that individuals have the knowledge and skills needed to perform a particular job and that the learning programme undertaken has delivered education at a given standard. It should be closely linked to certification so that the individual and the employer could come to know the competencies acquired through the vocational certification course. The assessment should be reliable, valid, flexible, convenient, cost effective and above all it should be fair and transparent. Standardised assessment tools should be used for assessment of knowledge of students. Necessary arrangements should be made for using technology in assessment of students.

5.1 SKILL ASSESSMENT (PRACTICAL)

Assessment of skills by the students should be done by the assessors/examiners on the basis of practical demonstration of skills by the candidate, using a competency checklist. The competency checklist should be developed as per the National Occupation Standards (NOSs) given in the Qualification Pack for the Job Role to bring about necessary consistency in the quality of assessment across different sectors and Institutions. The student has to demonstrate competency against the performance criteria defined in the National Occupation Standards and the assessment will indicate that they are 'competent', or are 'not yet competent'. The assessors assessing the skills of the students should possess a current experience in the industry and should have undergone an effective training in assessment principles and practices. The Sector Skill Councils should ensure that the assessors are provided with the training on the assessment of competencies. Practical examination allows candidates to demonstrate that they have the knowledge and understanding of performing a task. This will include hands-on practical exam and viva voce. For practical, there should be a team of two evaluators – the subject teacher and



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the expert from the relevant industry certified by the Board or concerned Sector Skill Council. The same team of examiners will conduct the viva voce.

Project Work (individual or group project) is a great way to assess the practical skills on a certain time period or timeline. Project work should be given on the basis of the capability of the individual to perform the tasks or activities involved in the project. Projects should be discussed in the class and the teacher should periodically monitor the progress of the project and provide feedback for improvement and innovation. Field visits should be organised as part of the project work.

Field visits can be followed by a small-group work/project work. When the class returns from the field visit, each group might be asked to use the information that they have gathered to prepare presentations or reports of their observations. Project work should be assessed on the basis of practical file or student portfolio.

Student Portfolio is a compilation of documents that supports the candidate's claim of competence. Documents may include reports, articles, photos of products prepared by students in relation to the unit of competency. Viva voce allows candidates to demonstrate communication skills and content knowledge. Audio or video recording can be done at the time of viva voce. The number of external examiners would be decided as per the existing norms of the Board and these norms should be suitably adopted/adapted as per the specific requirements of the vocational subject. Viva voce should also be conducted to obtain feedback on the student's experiences and learning during the project work/field visits.

6. Detailed Course Structure

6.1 Course Duration: 300 Hours (3 months)

Total Hours: 300 (Theory 90 hours, Practical 150 hours, OTJ 60 Hours)

The course is designed to provide comprehensive knowledge and practical skills in maintaining and repairing solar PV systems and their components. Each module includes both theoretical and practical sessions to ensure hands-on experience and real-world application.

6.2 Minimum Qualification:

10th pass + ITI/ Diploma (Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation, Welder) or Vocational Pass out in Technical/Engineering Background or High School Pass out.

6.3 Minimum Age: 18 Year

6.4 Learning Outcomes

Upon completion of this course, the learners will be able to:

- Describe the basic concept of Energy, Power and the basics of electricity.



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- Describe the use of solar energy and its application.
- Explain the Solar PV Technology (Basics, Solar Cells, PV Modules, Arrays)
- Discuss the Solar Power generation, including Solar thermal PV and current trend.
- Discuss the advantages of solar energy, including its abundance, sustainability, and environmental benefits.
- Understand the role of solar energy in reducing dependence on fossil fuels, combating climate change and achieving sustainability goals.
- Identify the key factors that influence the efficiency of solar energy systems, such as location, insolation, and sunlight availability.
- Identify the main components of a solar PV system, including solar panels, inverters, and batteries.
- Discuss the applications of solar PV technology in residential, commercial, and industrial establishments.
- Site Survey for installation of Solar PV System
- Assess the customer's Solar PV requirement
- Procure Solar PV system components
- Install Civil and Mechanical parts of Solar PV System
- Install Electrical components of Solar PV System
- Test and Commission Solar PV System
- Standards and Quality control
- Earthing of Solar PV Systems
- Maintenance of Solar Photovoltaic System
- Maintain Personal Health & Safety at project site
- Customer orientation for Solar PV System
- Cost economics of Solar PV Systems

Learners will be able to check, configure, install, inspect, test, and commission various components of photovoltaic systems that meet the performance and reliability needs of customers by incorporating quality craftsmanship and complying with all applicable codes, standards, and safety requirements.

6.5 Module Structure

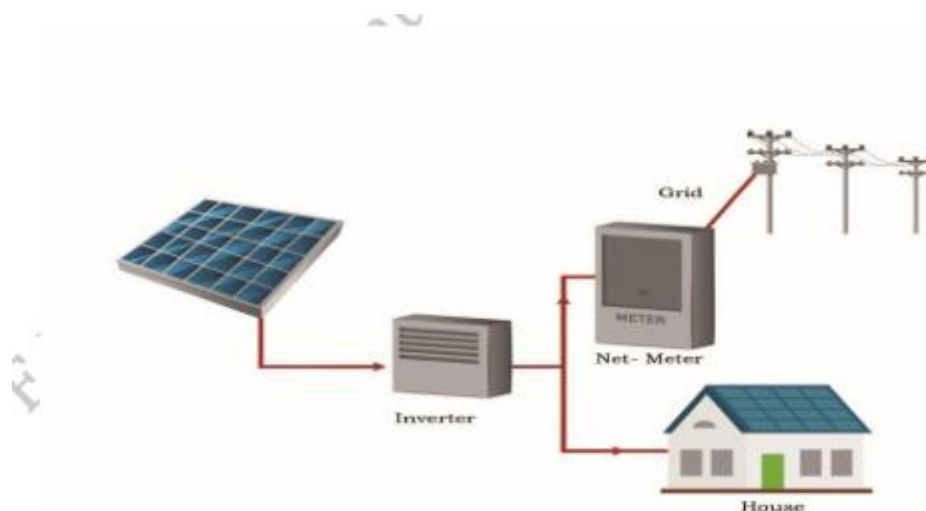
6.5.1. Module 1 – Introduction to Solar Energy

This module introduces learners to the fundamentals of energy with a focus on solar energy and photovoltaic technology. Students will understand solar applications in both grid-connected and off-grid contexts, current industry trends, and government initiatives such as PM Surya Ghar, PM KUSUM, and Solar Parks. Practical exposure includes familiarization with solar PV system components and site visits to installations such as solar water pumps, rooftop systems, and solar power plants.



6.5.2. Module 2 – Introduction to Solar PV Installer

This module explains the role of a Solar PV Installer, emerging job roles, and entrepreneurial opportunities. Learners will explore job prospects, self-employment options, the importance of digital literacy, career development, and workplace communication skills. Activities include group discussions, debates, and presentations to build confidence and teamwork.



6.5.3. Module 3 – Basics of Solar Energy and Electrical Concepts

This module builds the theoretical foundation of solar energy, electricity, and electrical concepts such as Ohm's Law, irradiance, irradiation, and solar insolation. Learners will explore sun paths, tilt angles, and perform basic calculations on power and energy. Practical work involves tilt angle demonstration, use of multimeters, sun-path finders, pyranometers, and other measuring instruments.

6.5.4 Module 4 – Site Survey and Customer's Solar PV Requirement

This module trains students in conducting site surveys, shadow analysis, load profiling, system sizing, and customer engagement. Learners will prepare site maps, assess load requirements, and optimize installation plans, while also exploring innovative solutions such as "Plug and Play" and "Behind the Meter" systems.

6.5.5. Module 5 – Basics of Solar PV Systems and Components

This module introduces solar PV system components including PV modules, inverters, charge controllers, batteries, junction boxes, cables, and mounting structures. Learners will study module types (poly, mono, bifacial, thin-film, etc.), data sheets, and quality standards. Practical's include component identification, performance comparison, cabling, and earthing demonstrations.



6.5.6. Module 6 – Interpretation of Drawings and Material Handling

This module emphasizes reading and interpreting Single Line Diagrams (SLD), layout diagrams, and Bills of Materials (BoM). Students will learn safe material handling, quality control, storage, and documentation practices. Practical activities include preparing drawings, assembling BoMs, and testing PV modules in series/parallel connections under varying conditions.

6.5.7. Module 7 – Tools and Equipment for Installation

Learners will gain hands-on experience with mechanical, electrical, civil, and safety tools used in PV system installation. The module covers measurement instruments, radiation meters, and installation of mounting structures, modules, and battery banks. Emphasis is placed on material optimization, waste management, and safety practices.



6.5.8. Module 8 – Installation of Electrical Components

This module focuses on installing inverters, batteries, junction boxes, meters, cables, and conduits. Students will learn DC and AC wiring, earthing, and grounding practices while ensuring adherence to safety standards. Practical's include string connections, distribution box wiring, capacity testing, and measuring voltage/current.



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6.5.9. Module 9 – Testing and Commissioning of Solar PV Systems

Students will learn procedures for testing, inspection, fault finding, and commissioning of PV systems. Topics include continuity checks, polarity tests, inverter operation, and grid interconnection standards. Practical sessions involve pre-commissioning checks, inverter functionality testing, battery performance evaluation, and grid synchronization.

6.5.10. Module 10 – Operation, Maintenance, and Troubleshooting

This module covers preventive, corrective, and condition-based maintenance. Learners will study cleaning methods, maintenance scheduling, troubleshooting common faults, and documentation practices. Practical's include cleaning panels, visual inspections, fault diagnosis, and troubleshooting of electrical components.

6.5.11. Module 11 – Health and Safety at Project Site

This module emphasizes workplace safety, hazard identification, first aid, and occupational health standards. Learners will practice safe handling of tools and materials, use of PPE, fire safety, and rescue operations. Mock drills, infection control, and good housekeeping practices form a major part of the practical training.

6.5.12. Module 12 – Completion, Handover, Documentation, and User Training

Learners will understand project closure processes including handover documentation, commissioning reports, warranty registration, and client training. Emphasis is placed on system start-up, shutdown procedures, and customer orientation. Practical's involve preparing checklists, templates, and hands-on documentation.

6.5.13. Module 13 – Employability Skills (DGT/VSQ/N0102)

This module equips learners with essential 21st-century skills including communication, digital literacy, financial awareness, entrepreneurship, and workplace ethics. Practical exposure includes computer skills (MS Office, internet tools), CV preparation, mock interviews, and career development planning.

6.5.14. Module 14 – Customer Relationship Management

The final module develops customer engagement skills. Learners will understand cost benefit analysis, payback periods, government incentives, and documentation for clients. Emphasis is on post-installation service, customer training, and building trust for long-term relationships.



7. Module Content

Module	Hrs	Theory	Hrs	Practical	Total hour
Module 01: Introduction to Solar Energy	03	• Introduction to Energy • Solar Energy • Solar PV Technology • Solar PV Applications, Grid-connected and off-grid • Solar Power Generation and Current Trend • Govts initiatives/schemes and programmes (PM Surya Ghar, PM KUSUM, Solar Parks, etc.)	03	• Identify the various components of a solar PV system. • Take trainees to actual installation sites of Solar PV water pumps, Solar lights, solar rooftops and solar power plants and explain the components, functioning and O&M of these systems.	06
ASSESSMENT	01		01		02
Module 02: Introduction to Solar PV Installer	03	• Explain the role of Solar PV Installer and emerging jobs & entrepreneurial opportunities in installation and O&M of solar rooftop and solar ground-mounted projects. • Illustrate the advantages of doing the course (Job prospects and self-employment). • Explain the importance of inculcating Digital Literacy & Skills along with career development and related goals setting. • Explain the importance of basic skills for communication; along with how to work effectively with others while	03	• Demonstrate how to interpret signs, notices and/or cautions at project site. • Organise group discussions • Organise debates and ppt by trainees	06



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		respecting gender and disability concerns.			
		- Explain the importance of reading and interpreting signs, notices and/or cautions at project site. - Demonstrate how to interpret signs, notices and/or cautions at project site.			
ASSESSMENT	01		01		02
Module 03:	04	- Solar Energy Fundamentals - Explain Ohm's Law and the basics of solar energy/electricity and electrical concepts. - Explain the relevance of Diffused Normal Irradiance (DNI) and Global Horizontal Irradiance (GHI), along with differences in Irradiance & Irradiation. - Illustrate the movement of the sun, the sun's path and assess its effect on the performance of the solar power plant. - Perform simple calculations to illustrate the fundamental concepts of power and energy. - Solar insolation, various angles of incident rays (Azimuth, tilt angles, etc.)	05	- Explain Sun's path and movements through models/ Videos/ PPTs. - Demonstrate the tilt angle of the solar panel as per the latitude of the location. - Perform the measurement of Current and Voltage using a Multimeter. - To test the continuity of electrical circuits and connections using a Multimeter. - Perform the practical on the sun-path finder, - Use of Pyranometers/watt-meter/ sun shine recorder, etc.	09
Basics of Solar Energy and Electrical concepts					
ASSESSMENT	01		01		02



Curriculum of Certificate Course on Solar PV System Installer and Maintenance

Module 04: Site Survey for Installation of Solar PV System and asses the customer's Solar PV Requirement	07 - Describe/Demonstrate how to observe the Sun path diagram and explain the importance of shadow analysis. - Explain the importance of assessing various site conditions for safe installation of solar PV system. - Identify and list the load to be connected to the Solar PV system. - Describe load profile. - Explain the importance of engaging with customers for any specific requirement and budget constraints while identifying opportunities for deploying innovative energy solutions like "Plug and Play" or "Behind the Meter" solution, where typical civil construction work may not be required. - Describe the importance of system sizing and explain its calculation with basic mathematical tools. - Demonstrate how to assess the site conditions for safe installation of Solar PV system and optimize route plan. - Demonstrate how to assess the load to be connected to the Solar PV system and how to prepare the load profile.	10 - Demonstrate the shading and its effect on performance of solar panels. - Demonstrate the load profile calculation of the user's home. - Take them at actual site and demonstrate the site selection step by step. - Demonstrate the preparation of site maps. - Demonstrate various measurements and how to calculate the system sizing. 17
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Curriculum of Certificate Course on Solar PV System Installer and Maintenance

		• Demonstrate how to engage with customers to meet their energy requirements, including through deploying innovative energy solutions like “behind the meter” system. • Perform system sizing calculations. • Show how to prepare a site map of the location where installation has to be carried out • Show how to decide on type of mounting to be created and explain customers about any civil work to be undertaken • Show how to identify processes where material/resource utilization including water can be optimized.		
ASSESSMENT	01		01	02
Module 05:	04	• Explain various terminologies used in the solar industry. • Identify the different components of a Solar PV system and explain its basic operation. • Explain the working of different types of Solar PV systems. • Discuss the latest and innovative technologies • Solar Cells (Various types-Silicon, thin film, perovskite, tandem etc.) • Describe and analyse the different types, sizes and	06	10
Basics of Solar Photovoltaic systems and its components			• Demonstrate the various components of PV systems i.e., PV Cells, Module, Junction box, DC cables, inverter, wiring techniques, charge controllers, mounting structures, fixtures and fasteners etc. • To study and compare the characteristics of Polycrystalline, Monocrystalline, and Bifacial solar PV modules. • Demonstrate various materials used in earthing. • Perform earthing at a small installation site as per standard procedure. • Cable colour coding in the bus bar.	



Curriculum of Certificate Course on Solar PV System Installer and Maintenance

		- specifications of modules, inverters, charge controllers, cables, conduits, junction boxes, solar batteries and allied accessories. - Explain and analyse the manufacturing data specification sheets of different types of solar PV components. - Demonstrate how to read and interpret various specifications and technical information listed on all key solar PV components. - Standards and Quality control - Earthing of Solar PV Systems	Demonstrate the Symbols and Signs of an Electrical connection.	
ASSESSMENT	01	01	02	
Module 06:	05	08	13	
Interpretation of Drawings, Material Handling and storage of components on-site	- Explain the importance of reading and rightly interpreting Single Line Diagram (SLD), Layout Diagrams, Civil/Mechanical and Electrical Drawings and demonstrate. - Describe the DO's and Don'ts of material handling; - Demonstrate the process of safe handling of material - Explain how to read and interpret the Bill of Material to verify with the delivery of components on-site. - Describe the importance of Preparing Bill of Materials (BoM)/ Demonstrate how to	- Demonstrate how to prepare the civil/electrical/mechanical drawings - Demonstrate how to prepare BoM including for portable and innovative solutions like Plug and Play or Behind the Meter system. - Explain the quality parameter for modules / panels, inverters, etc. matches with the requirement of the system. - To perform and observe the effect of connecting two or more solar PV modules in series. - To perform and observe the effect of connecting two or more solar PV modules in parallel. - To perform and verify the performance of solar PV		



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prepare BoM including for portable and innovative solutions like Plug & Play or Behind the Meter system. • Show how to ensure that all the components are handled and stored properly as per standard operating procedures • Show how to check materials received as per final BoM to ensure that the correct material for the job arrives on site and is damage free. • Show how to approach organization's warehouse/vendors, suppliers and/or manufacturers to place the order for components as per BoM • Show how to ensure that all materials are QC passed. • Show how to ensure quantity of modules / panels, inverters etc matches with the requirement of the system • Show how to report and document the status of material received at site and take appropriate action for replacements, if any • Identify and list any variation in material specification and design and explain how to submit the documented	modules connected in series and parallel combinations. • To observe the characteristics of a solar PV module under shading with bypass diode or when a bypass diode is not used. • To observe and follow safety measures during the handling and transportation of solar PV modules.
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Curriculum of Certificate Course on Solar PV System Installer and Maintenance

		variation to design team (if required) for approval or revised drawings			
		Identify materials which can be replaced by environment friendly substitutes and identify processes where material utilization can be optimized and accordingly suggest those to higher authority.			
ASSESSMENT	01		01		02
Module 07: Identification and Use of different tools and equipment used for installation of solar PV system	05	- Mechanical, electrical, civil, safety and General tools - Solar Radiation measurement, Pyranometer, - Explain/Demonstrate the function of different tools & equipment used for specific purpose in an installation of Solar PV system. - Explain the process of installing the mounting structure along with structural supports and accessories for safe & weather-proof installation as per site conditions. - Identify and demonstrate how to use various tools and tackles for civil/mechanical installation and identify best practices - Identify opportunities for material and energy	08	- Demonstration, identification & Handling of all types of tools used for installation and O&M. - Demonstrate process of installing the entire mounting structure/system along with structural supports and accessories for safe & weatherproof installation as per site conditions - Demonstrate how to install battery bank with battery rating, stand as per the drawings /manuals - Show how to follow waste management practices - To perform hand drilling operations for mounting and installation of solar system components. - To determine the effect of radiation intensity and temperature on the performance of a solar PV module. - Demonstrate the process of installing the entire mounting structure/system along with structural supports and accessories for safe & weatherproof	13



Curriculum of Certificate Course on Solar PV System Installer and Maintenance

		conservation, along with use of environmentally friendly materials in civil/mechanical installation		installation as per site conditions	
		• Show how to install modules as per layout diagram and fasten modules to structures • Demonstrate how to install battery bank stand as per the drawings/manuals • Demonstrate process for optimising the usage of material and energy conservation, along with promoting the use of environment friendly materials in solar PV installation • Explain and show how to follow waste management practices			
ASSESSMENT	01		01		02
Module 08:	08		12		20
Installation of Electrical components of a Solar PV System		• Explain and demonstrate how to install electrical components of solar PV system; including inverter, batteries, junction boxes, energy meters, cables, and conduits other electrical components • Show how to implement site safety plan and inspect & utilise electrical installation toolkit • Identify the difference between DC and AC wires. • Analyse how to perform DC wiring		• Demonstrate inverter rating and wiring/ string connection. • Perform DC distribution box and AC distribution box connection. • Demonstrate batteries capacity and cable connection. • Explain Importance of earthing and its necessity and perform AC and DC earthing connection for solar PV system. • Measure each cable voltage and current.	



Curriculum of Certificate Course on Solar PV System Installer and Maintenance

		• Explain the Do's and Don'ts of DC wiring • Identify and Demonstrate the application of tools & equipment used for cable and conduit installation. • Identify tools and equipment for electrical component installation for Solar PV Power plant • Show how to prepare battery bank enclosure/ racks, containment (if required), install battery terminal and interconnection cables • Discuss and show how to ensure that the conduits and cables are properly supported, secured and labelled • Demonstrate how to perform earthing and grounding work for the protection of solar PV system • Describe the importance of Earthing for the protection of solar PV system • Demonstrate demounting of solar PV power plant • Explain the significance and types of earth faults as per standards • Show how to clean the work area after completing the installation work		
ASSESSMENT	01		01	02
Module 09:	06	• Describe the importance of	12	• Pre-commissioning checks, voltage and testing of DC
				18



Curriculum of Certificate Course on Solar PV System Installer and Maintenance

Testing and Commissioning of Solar PV system

- conducting testing of all solar PV components and performing fault finding and analysis, continuity checks, polarity checks and other commissioning activities.
 - Explain how to prepare a testing and inspection report
 - Explain the concerned regulations & standards for grid interconnection.
 - Prepare the checklist for overall commissioning of PV System
 - Describe the commissioning process for the solar PV system.
 - Demonstrate how to perform testing of all components, along with fault finding & analysis, continuity checks, polarity checks and other commissioning activities
 - Show how to perform visual inspection, inspect mechanical, civil and electrical components
 - Show how to measure and verify inverter operation, including anti-islanding performance and measurement of AC system values, DC voltage, current in each string, and array for system operation
- strings, inverter functionality,
 - Demonstrate protection system checks, and finally, grid synchronisation and continuous monitoring.
 - To understand the charging and discharging process of a battery.
 - To study and record the charging & discharging characteristics of a battery under different conditions.
 - To calculate the power flow of a standalone solar PV system with DC load and a battery.
 - To calculate the power flow of a standalone solar PV system with AC load and a battery.



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		• Show how to verify workmanship and proficiency in using tools and equipment • Show how to initiate system startup procedures, measure and record voltage and other parameters, record anomaly and document changes. • Examine concerned regulations & standards for grid interconnection • Demonstrate the commissioning process for the Solar PV System.	
ASSESSMENT	01	01	02
Module 10: Operation and Maintenance of Solar Photovoltaic Power System, troubleshooti ng etc.	08	• Types of Maintenance (preventive /corrective/ Condition) • Explain how to carry out maintenance activities required for each component. • Discuss how to clean solar panels with water in low sunlight to remove dust, bird droppings, pollen, leaves, branches and snow for maximum energy output from the system • Explain different methods which are employed for cleaning modules/array including mechanical or robotic cleaning • Explain how to prepare and execute preventive maintenance schedule and reactive	• Perform proper cleaning process of solar PV panels. • Check generation report daily or monthly basis. • Perform Visual inspections should be conducted to check for damage to panels, wiring, inverters, and other components. Checking for loose connections, corrosion. • Performs Do's and Don'ts of AC/DC wiring, other electrical components.



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maintenance activities

- Explain the typical faults, their causes and resolution for all components
- Explain how to ensure that modules are routinely cleaned and inspect the system
- Explain how to identify the faults in the system when there is an interruption in power generation
- Discuss how to check current output, identify faulty module and perform standard troubleshoot measure
- Explain how to identify faults and damages and how to escalate it to seniors
- Discuss and show how to rearrange the tools, remove consumable and, maintain the documents after completing the job.
- Discuss and show how to clean the work area after completing the maintenance activity
- Demonstrate how to carry out maintenance work for each component
- Show how to wipe hard stains with a sponge/cotton and use cleaning agents to wipe off stains from the module framing.



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		• Demonstrate how to prepare and execute preventive maintenance schedule and reactive maintenance activities • Show how to routinely inspect the system and check those for shading, loose connections, any external damages etc • Show how to check output voltage and compare with expected output voltage • Demonstrate how to check that electrical connections as per specifications and mountings are stable • Demonstrate how to identify typical faults, their causes and resolution for all components • Show how to identify faults and perform standard troubleshooting • Show how to check working conditions of fuses, circuit breakers, cables, service panel connections, inverter etc and identify damage if any		
ASSESSMENT	01		01	02
Module 11:	08	• Explain the requirements for a safe work area. • Explain the importance of administering first aid. • Identify the Personal Protective Equipment	20	• Demonstrate Insulated tools, gloves, helmet and other protective for electrical work. • Perform using appropriate Personal Protective Equipment (PPE), adhering to electrical and mechanical safety
Maintain Personal Health & Safety at project site				28



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|--|---|
| <p>used for the specific purpose.</p> <ul style="list-style-type: none">• Identify the hazards associated with photovoltaic installations;• Identify work safety procedures and instructions for working at height.• Explain the importance of Occupational health & Safety standards and regulations for installation of Solar PV system.• Incorporate good housekeeping practices and infection control guidelines.• Show how to administer first aid to a victim and use correct method to move injured person during an emergency• Demonstrate the usage of personal protective equipment for ensuring safety during installation and O&M work.• Show how to follow recommended safe practices in handling physical, chemical, electrical and fire hazards and risk• Show how to handle all required tools, equipment and materials safely• Show how to use appropriate fire extinguishers for different types of fire• Show how to report immediately to concerned | <p>protocols, and being mindful of weather conditions and potential hazards.</p> <ul style="list-style-type: none">• Perform a mock drill for possible accidents during civil/ electric/ mechanical installations.• Demonstration for use of Rescue kits.• Demonstrate good housekeeping and infection control & prevention practices |
|--|---|



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		authorities regarding sign and symptoms of illness of self and other colleagues			
ASSESSMENT	01		01		02
Module 12: Completion, Handover Documentation and users training	05	- Explain how to prepare the checklist for handover of the solar power plant. - Explain how to prepare complete and final documentation including commissioning forms and operation procedure. - Explain how to record component serial numbers, file data sheet and complete equipment warranty registration - Discuss work safety procedures and instructions for handling heavy components - Describe start- up and shutdown procedure of a Solar PV system; - Demonstrate the process of filling in checklist and completing handover documentation process. - Demonstrate work safety procedures and instructions for handling heavy components at project site. - Demonstrate start-up and shutdown procedure of a solar PV system.	14	- Prepare list of different check list documents like installation details, testing and commissioning documents etc. - Prepare the template of documents to be hand over.	19
ASSESSMENT	01		01		02
Module 13: Employability Skills	08	Discuss the Employability Skills	15	Perform computer skills, including using software like MS Office, internet	23



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- required for jobs in various industries
- List different learning and employability related GOI and private portals and their usage
- 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
- Show how to practice different environmentally sustainable practices
- Discuss importance of relevant 21st century skills
- 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
- Describe the benefits of continuous learning
- Show how to use basic English sentences for everyday conversation in different contexts, in navigation, and understanding digital tools.
- Understanding the basics of starting a business and managing related tasks.
- Understanding environmental issues like global warming and practicing sustainable practices.



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- person and over the telephone
- Show how to read and understand text written in basic English
- Show how to write a short note/ paragraph / letter/e - mail using correct basic English
- Show how to create a career development plan with well-defined short- and long-term goals
- Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette
- Explain the importance of active listening for effective communication
- Discuss the significance of working collaboratively with others in a team
- Demonstrate how to behave, communicate, and conduct appropriately with all genders and PwD
- Discuss the significance of escalating sexual harassment issues as per POSH act
- Outline the importance of selecting the right financial institution, product, and service
- Demonstrate how to carry out offline and online financial



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- transactions, safely and securely
- Explain the list the common components of salary and compute income, expenditure, taxes, investments etc. Discuss the legal rights, laws, and aids
- Describe the role of digital technology in today's life
- Demonstrate how to operate digital devices and use the associated applications and features, safely and securely
- Discuss the significance of displaying responsible online behavior while browsing, using various social media platforms, e-mails, etc., safely and securely
- Show how to create sample word documents, excel sheets and presentations using basic features
- Show how to utilize virtual collaboration tools to work effectively
- Explain the types of entrepreneurship and enterprises
- Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal



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- risks with its mitigation plan
- Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per the requirement
- Show how to create a sample business plan for the selected business opportunity
- Describe the significance of analysing different types and needs of customers
- Explain the significance of identifying customer needs and responding to them in a professional manner
- Discuss the significance of maintaining hygiene and dressing appropriately
- Show how to create a professional Curriculum Vitae (CV)
- Demonstrate how to use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively
- Discuss the significance of maintaining hygiene and confidence during an interview
- Perform a mock interview
- Explain the list the steps for searching



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		and registering for apprenticeship opportunities			
ASSESSMENT	01		01		02
MODULE 14:	02	- Explain the benefits of using Solar PV systems. - Explain the Cost of the system, its payback and the benefits of the government scheme and incentives available. - Discuss about the Electricity bill, Saving by using Solar PV System and their contribution for saving Environment. - Discuss how to inform the customer about the Various components of system. - Discuss how to deliver built drawings, permits, O&M documentation, project photos and customer operation manual. - Discuss about the Location for system Installation. - Assure about providing "Post Installation Services" to the Customer.	01	Demonstration of Job Card and SOP	03
Customer relationship					
ASSESSMENT	01		01		02
Theory	76	Practical Total	136		
Lectures					
Total					
Assessment	14		14		
Total					
Theory with	90	Practical with	150		240
Assessment		Assessment			
OJT					60
	TOTAL		18 Credits		300



8. Credit Calculation

The Certificate Course on Solar PV System Installer and Maintenance follows the National Credit Framework (NCrF), where one credit equals 15 learning hours. For a total of 300 hours, the course carries 18 credits, distributed as 6 credits for classroom learning (90 hours), 10 credits for hands-on practical training (150 hours), and 2 credit for industry exposure or internship (60 hours). This balance of theory and practice ensures employability and meets the requirements of NSQF Level 4.

15-hour Lecture = 1 Credit; 15- hour Practical = 1 credit; 30- hour OTJ = 1 credit

Total 300 hours (Credits 18)

- Theory with Assessment = 90 hours (6 credits);
- Practical with Assessment =150 hours (10 credits);
- OTJ = 60 Hours (2 credits)

9. Roles and Responsibilities of Solar PV System Installer and Maintenance Technician

A Solar PV System Installer and Maintenance Technician is responsible for installing, testing, and maintaining solar photovoltaic (PV) systems in residential, commercial, and industrial settings. The role ensures proper site assessment, system design understanding, safe installation, and efficient functioning of solar systems, contributing to clean energy adoption and sustainable development.

1. Site Assessment

- Conduct site surveys to assess feasibility, roof condition, tilt, shading, and load capacity.
- Interpret design drawings and system layouts for installation planning.

2. System Installation

- Install PV modules, mounting structures, wiring, junction boxes, and balance-of-system components.
- Ensure correct tilt, orientation, and alignment of modules.
- Connect PV modules with inverters, batteries, and charge controllers (as applicable).

3. Electrical and Safety Compliance

- Carry out DC and AC wiring as per electrical codes and safety norms.
- Use tools, instruments, and PPE correctly for safe working practices.
- Test and verify system performance before handover.

4. System Maintenance and Troubleshooting

- Perform regular inspections, cleaning of modules, and preventive maintenance.
- Diagnose faults in PV systems, inverters, or batteries and carry out necessary repairs.



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- Maintain optimal system efficiency and reliability.
- 5. **Customer Interaction**
 - Provide guidance to customers on system operation, maintenance schedules, and safety.
 - Offer post-installation support and basic training to users.
- 6. **Documentation and Reporting**
 - Prepare installation and maintenance reports.
 - Keep performance records and compliance documentation.

10. List of Tools and Equipment

The tools and equipment required are:

S. No.	Tool / Equipment Name	Specification
1	Tool kit	Standard make containing all necessary electrician tools
2	Double ended flat spanner	6 mm to 32 mm (Set of 12), Chrome Vanadium Steel
3	Double ended ring spanner	6 mm to 32 mm (Set of 12), Insulated handle
4	Combination pliers	15 cm and 20 cm, Insulated
5	Side cutting pliers	15 cm, Insulated
6	Nose pliers	15 cm, Insulated
7	Wire stripper	For wires 0.5 mm ² to 6 mm ²
8	Electrician knife	Blade length 100 mm, insulated handle
9	Hack saw frame with blade	300 mm blade, adjustable
10	Hand crimping tools	For lugs 1.5 mm ² to 10 mm ²
11	Cable cutter	Up to 16 mm ² copper/aluminium cable
12	Screw driver	100 mm to 300 mm (Set of 5), insulated
13	Water level	1.5 m acrylic tube, accuracy ±0.5 mm
14	Measuring tape	0–5 m, steel body, LC 1 mm
15	Centre punch	100 mm, hardened steel



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16	Standard wire gauge	Range 0.5 mm to 6 mm, circular type
17	Vanier calliper	0–300 mm, least count 0.02 mm
18	Line Dori	50 m length, high tensile nylon
19	Chisel	150 mm to 200 mm, flat, hardened steel
20	Drill machine	10 mm, 500W, reversible, with accessories
21	Plumb bob	200 g brass body, string length 2 m
22	Sprit level	300 mm aluminium body, 3 vials
23	Flat file	200 mm, medium cut
24	Round file	200 mm, medium cut
25	Triangle file	200 mm, medium cut
26	Hand saw,	450 mm, wooden handle
27	PVC mallet,	300 g, double face
28	Ball pin,	500 g, insulated handle
29	hammer,	0.75 kg and 1 kg, with wooden handle
30	Safety helmet	ISI certified, high-density PE
31	Safety shoes	ISI certified, steel toe, shock resistant
32	Safety belt	Full body harness, ISI certified
33	Nose mask	Disposable, N95 type
34	Safety goggles	Polycarbonate, anti-fog, ISI certified
35	Ear plug	Reusable, noise reduction ≥ 25 dB
36	PVC hand glove	11 KV insulating, ISI certified
37	Cotton hand glove	Heavy-duty, 24 oz
38	Reflective jacket	Fluorescent with reflective strips
39	Safety Gloves	Rubber, shock-proof, ISI certified
40	Earthing Rod, Soldering Iron & Flux, Phase	Earthing rod copper bonded, soldering iron 25W, flux paste, 500V phase tester



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41	Safety Gloves	Rubber, heat resistant
42	Sequence Meter	3-phase, LED display
43	Earth tester	Digital, 0–2000 ohm
44	Clamp meter	AC/DC up to 1000 A, digital
45	Multi-meter	Digital, TRMS, 600 V
46	Megger	500V, insulation resistance tester
47	Water testing instrument (TDS meter)	Range 0–2000 ppm
48	Pyranometer	Range 280–2800 nm, ISO certified
49	Infrared Thermometer	Range -50°C to 550°C, LCD digital

Classroom Aids

The aids required to conduct sessions in the classroom are:

1. Projector
2. Computer/laptops
3. Internet connectivity
4. Whiteboard

11. Career Opportunities

Graduates of this certificate course will be well-prepared for a range of career opportunities in the renewable energy sector:

- **Entrepreneur:** Start a business offering solar PV system installation, operation, and maintenance services for households, industries, and institutions.
- **Solar PV Installer:** Work with renewable energy companies, EPC (Engineering, Procurement & Construction) firms, or government projects to install solar panels and related systems.
- **Maintenance Technician:** Provide specialized services in inspection, troubleshooting, and maintenance of solar power plants, rooftop systems, and off-grid solutions.
- **Project Assistant:** Support solar energy companies in planning, site assessment, and execution of solar installation projects.
- **Renewable Energy Service Provider:** Join organizations working in energy access, rural electrification, or green initiatives to promote sustainable power solutions.



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- **Educational/Training Roles:** Work as a trainer or instructor in vocational institutes, ITIs, or training centers, imparting knowledge and practical skills in solar PV technology.

12. List of Contributor

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13. REFERENCE

1. Curriculum of Solar Panel Installation Technician, L4- QP SGJ/Q0101, PSSCIVE, NCERT Bhopal
2. Curriculum of Solar Pump Technician, L4- QP- AGR/6701, PSSCIVE, NCERT Bhopal
3. Curriculum of Solar PV Installer- (Civil)-QP-SGJ/Q0103, PSSCIVE, NCERT Bhopal.
4. Textbook of Solar Panel Installation Technician, L4- QP SGJ/Q0101, PSSCIVE, NCERT Bhopal
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6. Textbook of Solar PV Installer- (Civil)-QP-SGJ/Q0103, PSSCIVE, NCERT Bhopal.
7. Participant Handbook of Solar PV Installer (Suryamitra), SGJ/Q0101, Ver. 1.0 NSQF Level 4, SCGJ, New Delhi.



About PSSCIVE Institute

The Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE) is an apex research and development organization in the field of vocational education. It is a constituent unit of National Council of Educational Research and Training (NCERT), established in 1993 by the Ministry of Education (MoE), Government of India. The Institute has a picturesque 38-acre campus at Shyamla Hills in Bhopal. It comprises six academic disciplines, namely Agriculture and Animal Husbandry, Business and Commerce, Engineering and Technology, Health and Paramedical Science, Home Science and Hospitality Management and Humanities, Science, Education and Research with 05 Centres.

The Institute is also a UNEVOC (International Project on Technical and Vocational Education) Network Centre in India, which coordinates all the activities, including communication with UNESCO-UNEVOC International Centre, Bonn, Germany. Through the network, the Centre shares knowledge and experiences related to all aspects of VET, exchange country experiences, and discuss issues of common relevance.



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