Skill India
कौशल भारत - कुशल भारत

Directorate General of Training

सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

CERTIFICATE COURSE ON

Rooftop Solar PV (Installation & Maintenance) -Trainer

NSQF LEVEL- 4.0

SECTOR – POWER

Rooftop Solar PV (Installation & Maintenance) - Trainer

Duration: 15 Hours

NSQF LEVEL- 4.0

(Version: 1.0)

Designed in 2024

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

&

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata – 700 091

CONTENTS

1. COURSE INFORMATION

1.1 GENERAL

During the 15 hours duration of Rooftop Solar PV (Installation & Maintenance) -Trainer course, a candidate is trained on professional skills & knowledge related to job role. The Broad components covered during the course are given below:

The course will equip candidates to effectively demonstrate the installation and maintenance activities of solar rooftop systems. The curriculum emphasizes best practices for the installation, testing, operation and maintenance of rooftop solar panels to ensure optimal performance and longevity.

1.2 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements:

S No.	Course Element	Notional Training Hours
1.	Professional Skill (Trade Practical)	10
2.	Professional Knowledge (Trade Theory)	05
	Total	**15**

1.3 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude through summative assessment at the end of the course as notified by the DGT from time to time.

The assessment will be conducted by Controller of examinations, DGT as per the guidelines. There will be a computer based summative test of 30 marks (15 questions each of 2 marks) with 30 minutes duration or as being notified by DGT from time to time.

The learning outcome and assessment criteria will be basis for setting question papers for final assessment.

2. GENERAL INFORMATION

Name of the Trade	**Rooftop Solar PV (Installation & Maintenance) -Trainer**
Reference NCO-2015	7421.1401, 2356.0100
NOS Covered	PSS/N9477, PSS/N9478, PSS/N9479, PSS/N9481
NSQF Level	4.0
Duration of Craftsmen Training	15 Hours
Entry Qualification	Instructor of ITIs/NSTIs/ IToTs in Solar Technician and Electrician trades
Instructors Qualification	Degree in Electrical/ Electrical and Electronics Engineering from recognized Engineering College/ university with two year experience in the relevant field. OR Diploma in Electrical / Electrical and Electronics Engineering from recognized board of technical education with three years' experience in the relevant field. OR Existing Instructors of ITIs/NSTIs/ IToTs of Solar Technician (Electrical) / Electrician CTS/ CITS trades. OR NTC passed in the Trade of "Solar Technician (Electrical)" With five years' experience in the relevant field.
List of Tools and Equipment	As per Annexure – I

3. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

LEARNING OUTCOMES

1. Demonstrate measurement of irradiance of different sources of light. (NOS: PSS/N9477)
2. Demonstrate various tests and measurement pertaining to PV Modules. (NOS: PSS/N9478)
3. Plan and demonstrate installation, connecting, testing and commissioning of rooftop solar panel, charge controller, battery bank and Inverter. (NOS: PSS/N9479)
4. Demonstrate Operation & Maintenance of rooftop solar panel with best practices. (NOS: PSS/N9481)

4. SYLLABUS

SYLLABUS – Rooftop Solar PV (Installation & Maintenance) -Trainer			
Duration: 15 Hours.			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 02 Hrs.; Professional Knowledge 01 Hrs.	Demonstrate measurement of irradiance of different sources of light.	1. Measure intensity of solar radiation. 2. Analyse shadow effect on incident solar radiation and find out contributors.	• Solar energy fundamentals. • Study of Sun path (east to west, North to south and south to north movement). • Sun path Diagram • Importance of Solar Energy for various application. • Basic of Site Selection • Tilt Angle and Azimuth Angle • Optimum orientation for solar PV Plant
Professional Skill 02 Hrs.; Professional Knowledge 01 Hrs.	Demonstrate various tests and measurement pertaining to PV Modules.	3. Measure Insulation resistance and Wet Leakage Current of rooftop solar panel. 4. Perform Bypass Diode test -Pmax at STC and Pmax at low irradiance. 5. Measure Ground Continuity, Impulse Voltage, Reverse current and Partial Discharge. 6. Demonstrate hot spot on modules through audio visual aids.	• Hot spot-on modules and method to detect them at site. • Safety related to solar panel installation. • Safety at rooftop.
Professional Skill 04 Hrs.; Professional Knowledge 02 Hrs.	Plan and demonstrate installation, connecting, testing and commissioning of rooftop solar panel, charge controller, battery bank and Inverter.	7. Demonstrate Mounting , grouting and Installation of Solar Panel. 8. Demonstrate Earthing Installation. 9. Connect solar panels to an Array Junction box. 10. Connect Solar panel, Solar charge controller, Solar	• Understanding customer's requirement. • Solar panel terminal wires and MC-4 connectors. • Choice of wires (DC cables) used in the solar PV Electrical system. • PWM charge controller. • MPPT charge controller.

		battery and a normal inverter and convert to a solar inverter. 11. Connect Solar PCU to Solar panel installation using a suitable battery bank and test the performance. 12. Demonstrate testing and commissioning of rooftop solar panel.	• Overview of Sequence of connection (step wise) in an off-grid system. • Types of Inverters: - Standalone, Grid Tied (MPPT/Central/String), Micro inverter. • Classification of inverters- • Stand alone or off-grid inverter, Hybrid inverter, Grid-tie inverter. • Earthing Installation
Professional Skill 02 Hrs.; Professional Knowledge 01 Hrs.	Demonstrate Operation & Maintenance of rooftop solar panel with best practices.	13. Demonstrate Standard Operating Procedures of rooftop solar panel. 14. Demonstrate Electrical Maintenance of Inverters/ Cables/ Junction Boxes, Fault Indications of Inverters/PCU. 15. Demonstration of rooftop solar panel maintenance: - Cleaning, DC Array Inspection, Precautions While Cleaning. 16. Demonstration of Battery Maintenance- Checking of Electrolyte Level, Specific Gravity Using Hydrometer, Physical Damage, Terminal Voltage, Cleaning of Battery Terminals. 17. Inspection of Mounting Structure of Solar Modules and procedure of replacement of defective fixtures.	• SOP (Standard Operation Procedures) of rooftop solar system. • Types of Maintenance (Preventive/Corrective/Condition Based). • Electrical maintenance /Solar Panel maintenance/ Battery maintenance/ Charge Controller maintenance

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Demonstrate measurement of irradiance of different sources of light. (NOS: PSS/N9477)	Measure intensity of solar radiation.
	Analyze shadow effect on incident solar radiation and find out contributors.
2. Demonstrate various tests and measurement pertaining to PV Modules. (NOS: PSS/N9478)	Measure Insulation resistance and wet Leakage Current of rooftop solar panel.
	Perform Bypass Diode test -Pmax at STC and Pmax at low irradiance.
	Measure Ground Continuity, Impulse Voltage, Reverse current and Partial Discharge.
	Demonstrate hot spot on modules through audio visual aids.
3. Plan and demonstrate installation, connecting, testing and commissioning of rooftop solar panel, charge controller, battery bank and Inverter. (NOS: PSS/N9479)	Demonstrate Mounting and Installation of Solar Panel.
	Demonstrate Earthing Installation.
	Connect solar panels to an Array Junction box.
	Connect Solar panel, Solar charge controller, Solar battery and a normal inverter and convert to a solar inverter.
	Connect Solar PCU to Solar panel installation using a suitable battery bank and test the performance.
	Perform Testing and commissioning of rooftop solar panel.
4. Demonstrate Operation & Maintenance of rooftop solar panel with best practices. (NOS: PSS/N9481)	Demonstrate Standard Operating Procedures of rooftop solar panel.
	Demonstrate Electrical Maintenance of Inverters/ Cables/ Junction Boxes, Fault Indications of Inverters/PCU.
	Demonstration of Solar Panel Maintenance: - Cleaning, DC Array Inspection, Precautions While Cleaning.
	Demonstration of Battery Maintenance- Checking of Electrolyte Level, Specific Gravity Using Hydrometer, Physical Damage, Terminal Voltage, Cleaning of Battery Terminals
	Inspection of Mounting Structure of Solar Modules, Procedure of replacement of defective Fixtures.

ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
Rooftop Solar PV (Installation & Maintenance) -Trainer			
Sl. No. 1 to 60 items are not required if NSTIs/IToT having affiliation in Electrician and Electronics Mechanic trades			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
1.	Measuring Steel Tape	5 meter	06 Nos.
2.	Combination Plier Insulated	200 mm	06 Nos.
3.	Screw Driver Insulated	4mm X 150 mm, Diamond Head	06 Nos.
4.	Screw Driver Insulated	6mm X 150 mm	06 Nos.
5.	Electrician screw driver thin stem insulated handle	4mm X 100 mm	06 Nos.
6.	Heavy Duty Screw Driver insulated	5mm X 200 mm	06 Nos.
7.	Electrician Screw Driver thin stem insulated handle	4mm X 250 mm	06 Nos.
8.	Hammer, cross peen with handle	250 grams	06 Nos.
9.	Hacksaw frame (with blade)	Adjustable 300 mm Fixed 150 mm	2 Nos. Each
10.	Pliers long nose insulated	150 mm	4 Nos.
11.	Pliers flat nose insulated	200 mm	4 Nos.
12.	Pliers, round nose insulated	100 mm	4 Nos.
13.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
14.	Gauge, wire imperial stainless steel marked in SWG & mm	Wire Gauge - Metric	2 Nos.
15.	Portable Electric Drill Machine	0-12 mm capacity 750W, 240V with chuck and key	1 No.
16.	Crimping Tool	1. 1.5 sq mm to 16 sq mm 2. 16 sq mm to 95 sq mm 3. MC 4 connector	1 No. Each
17.	Pliers Side Cutting	150 mm	2 Nos.
18.	Wire stripper adjustable length		2 Nos.
19.	Hammer, ball peen With handle		2 Nos.
20.	Load Bank (variable)	Up to 1.2 KW (Lamp / heater Type)	1 No.
21.	Rooftop Mounting Structure	For 3 x 335 Wp solar panels mounting practice, with tilt adjustment (as per available in market)	2 sets
22.	SPD	DC & AC	2 Nos. each
23.	MCCB	100Amps, Triple pole	1 No.

24.	ELCB and RCCB	25Amps, double pole and 25Amps, double pole, 30 mA	1 Each
25.	Solar cable (Red)	6 square mm	As required
26.	Solar cable (Black)	6 square mm	As required
27.	Battery cable	7.5 sq mm	As required
28.	MC – 4 connectors	1 way, 2 way, 3 way & 4 way	As required
29.	lugs	7.5 mm	As required
30.	Bolts, nuts, anchor bolts, washers, screws, other pins, lugs etc		As required
31.	Multi meter	Digital 0 to 2 M Ohms, 2V to 700 V,100 micro A to 10A DC and AC	02 Nos.
32.	Insulation tester	Analog - 500 V	01 No.
33.	Earth tester	0 to 100 ohm (analog)	01 No.
34.	Hydrometer	Lead acid type	04 Nos.
35.	1 KW Solar PV power plant	Grid tie type with suitable panels, AJB, Inverter, AC/DC cables, safety devices and grid tie arrangement	01 No.
36.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type) (AC & DC)	1 No. each
37.	Magnetic compass		04 No.
38.	Lead Acid battery (VRLA gel)	12V, 75Ah	01 No.
39.	Lead Acid battery (tubular)	12V, 40 Ah	01 No.
40.	Solar simulator for solar cell characteristic study	To study IV curve of a solar cell of minimum 2 watt under variable illumination, temperature and suitable load	01 No.
41.	Solar energy trainer with grouping of solar cells	To group (series or parallel) at least six solar cells each with minimum 2 W with suitable loads	01 No.
42.	Halogen lamp with stand for illumination of solar panels in lab	AC mains operated to provide 0 to 1000 watts per meter square	02 Set
43.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	01 No.
44.	Solar photovoltaic module	5W, 10W, 40W, 75W, 265W	05 Each
45.	Solar panels	335 Wp	03 Nos.
46.	Solar Charge controller with Dusk to Dawn automatic switching	12V 10A, 24V 20 A	01 No. each
47.	Solar charge controller with manual switch (Day lighting)	12 V, 20 A	02 Nos.
48.	Array junction box	for connecting 265W x 4 Nos. solar panel with DC fuse, DC MCB, and surge suppressor protection	02 Nos.
49.	Home light system	12 V DC with FM receiver, LED bulb and mobile charger as loads	1 No.
50.	Clinometer	for Angle measurement	1 No.
51.	Spirit level	For floor level check	1 No.

52.	DC table fan	12 V, 15W	1 No.
53.	A.C. Energy Meter	Single Phase, 10 A, 240 V induction type	01 No.
54.	Net meter	Single Phase, 10 A, 240 V induction type	01 No.
55.	Inverter with Battery	0.5KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	01 No.
56.	Solar PCU	Off grid 1 KW MPPT Sine wave Solar Power Conditioning Unit	04 Nos.
57.	Complete Solar Grid tied inverter with Remote Monitoring System Panel Demonstrator kit	1 KW	1 No.
58.	Instructor's table		01 No.
59.	Instructor's chair		01 No.
60.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	02 Nos.

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in designing/ revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

Trade committee meeting to finalize the syllabus of "Rooftop Solar PV (Installation & Maintenance) -Trainer" (15 hrs.) held on 22.05.2024 at CSTARI, Kolkata			
Sl. No.	**Name and Designation (Shri/Smt./Kumari)**	**Organization with Address**	**Remarks**
1.	Sunil Kumar Gupta, DDG (ER)	CSTARI, Kolkata	Chairman
2.	Gautam Chandra Saha, JD/HOD		Member
3.	Surja Sekhar Shaw, Instructor (Wireman)	Govt. ITI, Suri- Birbhum	Member
4.	Debasish Mondal, Assist. Professor (EE)	Saroj Mohan Institute of Technology	Member
5.	Rahul Gupta, Instructor (Electrician)	Govt. ITI, Suri- Birbhum	Member
6.	Anupam Baral, Founder & CEO	Geetanjali Solar Enterprise, Kolkata	Member
7.	Pradip Kumar Mondal, Instructor (Electrician)	Govt. ITI, Gariahat	Member
8.	Sk. Altaf Hossain, Asst. Director	CSTARI, Kolkata	Member
9.	B. Sharanappa, Asst. Director	CSTARI, Kolkata	Member
10.	Bharat Kumar Nigam, TO	CSTARI, Kolkata	Member
11.	K.V.S. Narayana, TO	CSTARI, Kolkata	Member
12.	P.K. Bairagi, TO	CSTARI, Kolkata	Member