Syllabus for Solar Pump Installation and Service Technician

Course Name	Solar Pump Installation and Service Technician
Sector	AGRICULTURE
Course Code	AGR/2024/SPST/369
Level	4
Occupation	Solar Pump Installation and Service Technician
Job Description	A Solar Pump Installation and Service Technician is responsible for demonstrating the operation of solar pumps with Variable Frequency Drive (VFD), explaining electrical fundamentals and solar energy applications of solar panel. The candidates is also responsible for executing the installation process of solar panels & pumps, performing plumbing work for solar pump integration and identifying, troubleshooting and repairing issues within solar pump systems.
Course Duration	Total Duration 390 Hrs (T-90, P-180, OJT-60 and ES-60)
Trainees' Entry Qualification	• 12th grade pass • Completed 2nd year of 3-year diploma (after 10th) • Pursuing 2nd year of 3-year regular Diploma (after 10th) • 10th grade pass with two years of any combination of NTC/NAC/CITS or equivalent. • 8th pass plus 2-year NTC plus 1-Year NAC plus 1-Year CITS • 10th grade pass and pursuing continuous schooling (for 2-year program) • 11th Grade Pass and pursuing continuous schooling • Previous relevant Qualification of NSQF Level 3.0 with minimum education as 8th Grade pass with 3-year relevant experience Previous relevant Qualification of NSQF Level 3.5 with 1.5-year relevant experience
Trainers Qualification	Diploma in Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation, Agriculture engineering with 3yrs experience in relevant field OR I.T. I in Electrical, Electronics, Civil, Mechanical, Fitter, Instrumentation with 3yrs experience in relevant field OR B. Tech. / BE in Civil/Mechanical/ Electrical/ Instrumentation /Electronics /Electrical and Electronics Eng./ Agriculture engineering with 2yrs experience in relevant field OR M.Tech. in Civil/ Mechanical/ Electrical/ Instrumentation /Electronics/ Electrical and Electronics Eng./ Agriculture engineering with 2yrs experience in relevant field.

Structure of Course:

Module No.	Module name	Outcome	Theory (Hrs)	Practical (Hrs)	Total (Hrs) [Multiple of 30]
1	Pumps Technologies	Explain the distinguishing features and application of various pumps, including solar-powered systems with controller, through product demonstrations and hands-on operation.	10	20	30
2	Fundamentals of Solar Panel	Explain the Electrical Fundamentals and Solar Energy Applications of Solar Panel	10	20	30
3	Solar Panel & Pump Installation	Demonstrate installation process of Solar Panel & Pump.	20	40	60
4	Plumbing for Solar Pump Integration	Execute plumbing work for solar pump integration.	20	40	60
5	Troubleshooting and Repairs	Identify Troubleshoot and Repair of solar pump systems.	20	40	60
6	Work Safety & Procedure	Apply health and safety practices at the workplace.	10	20	30
7	OJT	Work in real job situation with special emphasis on basic safety and hazards in this domain (OJT).	--	60	60
8	Employability Skill	As per guided curriculum	60	--	60
		TOTAL:	150	240	390

SYLLABUS:

Module No. 1: Pumps Technologies

Outcome: Explain the distinguishing features and application of various pumps, including solar-powered systems with controller, through product demonstrations and hands-on operation.

Theory Content:

- DC, AC & other Different Types of Pumps
- Surface Pump from 0.25 Hp & above
- Submersible Pump from 1 Hp - 10 Hp
- Advantages and disadvantages of solar pumps
- Understanding solar pumps, their components,
- Identify the types of solar pumps: submersible and surface pumps.
- Identify type of pump- DC or single phase/3 phase AC, Duel (electrical/ solar) operated pump,
- Explain function of Various Capacity/ Design of Pump Controllers VFD (Variable Frequency Drive) panel
- Working principles of solar-powered water pumping systems

Practical Content:

- Product demonstration
- Function of pump components
- Operate the solar-powered pump during daylight hours
- Control solar pump motors speed using Variable Frequency Driver (VFD).

Tools & Equipment needed: Plier, pumps of various capacity, screw driver, wrench as per size/capacity, pump controller (VFD), insulation tape, Lugs, Ties, Clamp.

Module No. 2: Fundamentals of Solar Panel

Outcome: Explain the Electrical Fundamentals and Solar Energy Applications of Solar Panel

Theory Content:

- Explain Fundamental of electricity like electric current, voltage, power and their units along with Ohms law, Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL).
- Describe the use of multimeter and its usage.
- State the type & efficiency of various solar cell like *Monocrystalline* or Polycrystalline.
- Discuss the nature of load (AC or DC) connected to solar PV System.
- Identify the load requirement for solar pump
- Overview of solar energy and its applications

Practical Content:

- Measure the electrical parameter using Ammeter, Voltmeter, Wattmeter and Multimeter
- soldering and desoldering techniques.

- Identify the SPV by observing the panel.
- Calculate how to connect units as per load requirement.
- Calculate how many units should be connected in series and parallel.

Tools & Equipment needed: Multimeter, Screw driver, plier, Measuring tape, cutter, Solar panel.

Module No. 3: Solar Panel & Pump Installation

Outcome: Demonstrate installation process of Solar Panel & Pump.

Theory Content:

- Explain Mounting Structure for solar panel
- Module Mounting Structure - Single, Dual Axis & Fixed
- Identify junction box, charge controller, battery, stand-alone inverter etc.
- State block diagram of a solar PV system with Solar unit, Junction box, Charge controller, Inverter.
- DC/AC Armoured & Non-Armoured Cable/ Flat Cable
- Solar Pump connection
- Describe the junction box, MCB, ELCB, MCCB, etc.
- Discuss about the method to set tilt angle in summer and winter.
- Explain installation procedure of solar pump including Submersible Pump Boring Size according to the Pump Capacity
- Submersion & Installation of Submersible Pump
- Earthing & Lightning Arrestor

Practical Content:

- Demonstrate how to assemble solar units in series and parallel.
- Assemble all units to a junction box through diode.
- Connect the junction box to a charge controller.
- Connect the charge controller to a battery.
- Connect the battery to a stand alone inverter.
- Execute inverter to Solar Pump connection.
- Calculate the tilt angle of a solar panel in summer and winter, i.e. Latitude +/- 15
- Set the tilt angle of solar panel in summer and winter.
- Site assessment and selection for solar pump installation
- Designing the layout for solar pump installation
- Step-by-step guide to installing solar pumps

Tools & Equipment needed: Solar panel, Structure, SS bolt & nut, washer, AC/DC cable, Insulation tape, LUGS & TIES, Clamp, PVC pipe, flexible pipe, wooder gutka, spade, Agar, Variegated, foundation bolt, GI strip, earth pit, drill machine, hammer, screw driver, clamp meter, wire connector, MCB, crimping tool, pump controller, Teflon tape, steel rope, PVC boring pipe, measurement tape, change over.

Module No. 4: Plumbing for Solar Pump Integration

Outcome: Execute plumbing work for solar pump integration.

Theory Content:

- Overview of plumbing systems, Study of source of water, concept of aquifer/water reservoir.
- Importance of sustainable and eco-friendly plumbing practices
- Plumbing systems and their application in Plumbing
- Basic plumbing tools and equipment
- Design considerations for integrating solar pumps into plumbing systems
- Sizing and selecting components for optimal performance
- Calculating water demand and designing plumbing layouts

Practical Content:

- Distribution and Lay out of Pipe lines.
- Identify and select different type & size of Pipes.
- Connection of pipe

Tools & Equipment needed: Teflon tape, solvent selant, Hacksaw blade, Pipe wrench.

Module No. 5: Troubleshooting and Repairs

Outcome: Identify, Troubleshoot and Repair of solar pump systems.

Theory Content:

- Identifying common issues with solar pump systems
- Troubleshooting techniques and problem-solving
- Emergency repairs and maintenance protocols

Practical Content:

- Troubleshooting common installation issues
- Regular maintenance schedules for solar pump system
- Replacing and upgrading components when necessary

Tools & Equipment needed: Multimeter, screw driver, plier, tester, Pump component, VFD component.

Module No. 6: Work Safety & Procedure

Outcome: Apply health and safety practices at the workplace.

Theory Content:

- Discuss job-site hazards, risks and accidents.
- Describe different ways of preventing accidents at the workplace.
- Discuss about safety equipment.
- Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials.

Practical Content:

- Demonstrate the use of protective equipment suitable as per tasks and work conditions.

- Demonstrate the application of defined emergency procedures such as raising alarm, safe evacuation, moving injured people, etc.
- Demonstrate how to use safety equipment.
- Demonstrate how to maintain cleanliness after task is completed.

Tools & Equipment needed: Personal protective Equipment, Fire extinguisher, First Aid Box, Safety clothing, Ladders.

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 **60 Hours.**)

Module No. 8: Employability Skills **(60 Hrs)**

Key Learning Outcomes

Introduction to Employability Skills Duration: 1.5 Hours

After completing this programme, participants will be able to:

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	Explain the distinguishing features and application of various pumps, including solar-powered systems with controller, through product demonstrations and hands-on operation.	**After completion of this module students will be able to:** • Differentiate between various types of pumps including surface and submersible pumps. • Explain the components of solar pumps. • Demonstrate solar pumps operation including their advantages and disadvantages • Identify the appropriate pump type for different applications. • Control the speed of solar pump motors using Variable Frequency Drive (VFD). • Demonstrate the operation of solar pumps including the function of pump components during daylight hours.
2	Explain the Electrical Fundamentals and Solar Energy Applications of Solar Panel	**After completion of this module students will be able to:** • Explain Fundamental of electricity like electric current, voltage, power and their units along with Ohms law, Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL). • Measure electrical parameters using instruments such as ammeter, voltmeter, and wattmeter. • Demonstrate soldering and desoldering techniques. • Describe the characteristics and efficiency of different solar cell types including monocrystalline and polycrystalline. • Describe the nature of loads (AC or DC) connected to solar PV systems.

Module No.	Outcome	Assessment Criteria
		• Identify the load requirements for specific applications such as solar pumps. • Describe solar energy fundamentals and its various applications. • Identify solar photovoltaic panels and explain their configurations.
3	Demonstrate installation process of Solar Panel & Pump.	**After completion of this module students will be able to:** • Explain the mounting structure for solar panels and differentiate between single, dual-axis and fixed structures. • Recognize and identify components such as junction box, charge controller, battery, stand-alone inverter, etc., within a solar PV system. • Comprehend electrical components including DC/AC Armoured & Non-Armoured Cables, Flat Cables, junction boxes, MCB, ELCB, MCCB, etc. • Demonstrate the procedure of setting tilt angles for solar panels in summer and winter. • Connect the junction box to a charge controller and subsequent connection to a battery. • Connect the battery to a stand-alone inverter and execute of inverter to a solar pump connection. • Apply tilt angles for solar panels in both summer and winter conditions. • Design layouts for solar pump installations considering factors such as pump capacity, submersible pump boring size, etc. • Execute step-by-step installation procedures for solar pumps including submersion. • Install submersible pumps, earthing and lightning arrestor.
4	Execute plumbing work for solar pump integration.	**After completion of this module students will be able to:** • Demonstrates plumbing systems including sources of water and aquifers/reservoirs. • Design considerations for integrating solar pumps into plumbing systems. • Select and use basic plumbing tools and equipment. • Design plumbing layouts for solar pump integration based on water demand. • Executes the distribution and layout of pipelines. • Identify and select appropriate types and sizes of pipes for the intended application.
5	Identify, Troubleshoot and Repair of solar pump systems.	**After completion of this module students will be able to:** • Identify common issues with solar pump systems • Apply troubleshooting techniques to diagnose problems within solar pump systems • Analyze and solve problems related to solar pump

Module No.	Outcome	Assessment Criteria
		systems • Implement regular maintenance for solar pump systems including preventive measures and corrective actions. • Identify, select and install appropriate components for replacement or upgrades in solar pump systems.
6	Apply health and safety practices at the workplace.	**After completion of this module students will be able to:** • Describe different ways of preventing accidents at the workplace. • Demonstrate the use of protective equipment suitable as per tasks and work conditions. • Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials. • Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials. • Maintain cleanliness after task is completed.
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 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 60 Hours.)
8	Employability Skill	As per guided curriculum

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

Sl No	Items Name	Specification	Qty
1	Pliers		5
2	Pumps of various capacity		1 set
3	Screwdriver		5
4	Wrench (as per size/capacity)		5
5	Pump controller (VFD)		1
6	Insulation tape		As required
7	Lugs		As required
8	Ties		As required
9	Clamp		As required
10	Multimeter		3
11	Measuring tape		5
12	Cutter		5
13	Solar panel		As required
14	Structure		As required
15	SS bolt & nut		As required
16	Washer		As required
17	AC/DC cable		As required
18	PVC pipe		As required
19	Flexible pipe		As required
20	Spade		5

Sl No	Items Name	Specification	Qty
21	Wooder gutka		As required
22	Foundation bolt		As required
23	GI strip		As required
24	Earth pit		2
25	Drill machine		2
26	Hammer		4
27	Clamp meter		3
28	Wire connector		15
29	MCB		3
30	Crimping tool		3
31	Teflon tape		As required
32	Steel rope		As required
33	PVC boring pipe		As required
34	Change over		As required
35	Solvent sealant		As required
36	Hacksaw blade		10
37	Pipe wrench		5
38	Tester		5
39	Pump component		1 set
40	VFD component		1 set
41	Personal protective equipment		5
42	Fire extinguisher		1
43	First Aid Box		1
44	Safety clothing		5
45	Ladders		1

Marks Distribution

Outcome	Outcome Code	Total Th marks	Total Pr marks	Total OJT marks
Explain the distinguishing features and application of various pumps, including solar-powered systems with controller, through product demonstrations and hands-on operation.	AGR/0271/OC1	20	90	0
Explain the Electrical Fundamentals and Solar Energy Applications of Solar Panel	AGR/0271/OC2	20	90	0
Demonstrate installation process of Solar Panel & Pump.	AGR/0271/OC3	30	130	0
Execute plumbing work for solar pump integration.	AGR/0271/OC4	30	130	0
Identify Troubleshoot and Repair of solar pump systems.	AGR/0271/OC5	30	130	0
Apply health and safety practices at the workplace.	AGR/0271/OC6	20	80	0
Work in real job situation with special emphasis on basic safety and hazards in this domain (OJT).	AGR/0271/OC7	0	0	150
Employability Skills – 60 Hrs	DGT/VSQ/N0102	50	0	0