



Solar Photovoltaic Training

Curriculum

Certificate level - 3 Months



Islamic Republic of Pakistan
اسلامی جمہوریہ پاکستان
Islami Jumhuri-ye Pakistan



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Overall Objective of the course

Enable the trainees to perform routine skilled and semi-skilled tasks to carry out Solar Photovoltaic installations & maintenance jobs and assist other team members in assigned preventive maintenance, installations, and repairs of Solar equipment, facilities and systems.

Competencies gained after completion of the course

The learner will gain competencies to:

1. Carry out electrical/electronic Installations.
2. Installation of Solar PV system.
3. Sense of different types of batteries, charge controller and inverters.
4. Operations and maintenance of PV system.
5. Inspect, test trace and repair Solar System faults
6. Safety precautions
7. How to manage and reduce a Load
8. Prepare estimates for Solar Installation.
9. Sense of different Renewable Energies

Job Opportunities available immediately and in future

After completing this course, learner will have following career opportunities:

- Offer services as a solar Technician to an electrical shop, industry and to building contractors.
- Work as an Solar Technician in Public and Private Organizations.
- Seek employment in Industries (having Solar Setup)
- Setup of his or her enterprise.
- Work as Contractor for Annual Maintenance/Repair of solar systems

Skill Standards

The certificate in the occupation of Solar PV Technician will be awarded to those who are competent in the following four units:

- Carry out solar system installations
- Install , service and repair/replace solar PV system
- Prepare estimates for solar related installations

Curriculum Delivery Structure

	Days	Description
Curriculum Delivery	54	
Quiz	9	End of every week
Monthly Exams	2	End of Every Month (Except last)
Final Exam	1	End of the Course
Total	66	-

Overview about the program

Module title and aim	Learning units	Theory hours	Workplace hours
<p>Module 1: Introduction to Basic Electrical system.</p> <p>Aim: This module covers the basic understanding of Electrical/Electronic systems. Formulas that are used to explain the Electrical terms and symbols that relates electrical system.</p>	<p>LU-1 Basic Electrical Terms and drawings</p> <p>LU-2 Electrical Measuring Instruments</p> <p>LU-3 Precautions and safety</p> <p>LU-4 Wiring Standards and layouts</p>	14 Hours	10 Hours
<p>Module 2: Introduction to Basic PV system.</p> <p>Aim: This module covers the basic understanding of PV system and the components that are involved in the solar system.</p>	<p>LU-1 Understanding of the components involved in solar system</p> <p>LU-2 Learning Data sheets, Circuit diagrams, and other specifications of products</p>	5 Hours	10 Hours
<p>Module 3: Feasibility and Designing of Solar PV system.</p> <p>Aim: This module covers the Analysis of load, Calculations involved in choosing/ Selecting solar components, create backups and wiring/connections related to solar panels including ducting and piping.</p>	<p>LU-1 Load analysis and Calculations for load.</p> <p>LU-2 Wiring Standards and layout for both AC and DC systems</p> <p>LU-3 Calculations for Components involved in Solar System</p> <p>LU-4 Selection of components involved in Solar System</p>	15 Hours	15 Hours
<p>Module 4: Installation Of Solar PV system.</p> <p>Aim: This module covers the installation/Orientation of solar system including Solar Frames, railings and mounting. It will also cover testing and efficiency measuring, connection types.</p>	<p>LU-1 Solar System being used in the world.</p> <p>LU-2 Orientation of Solar Panel</p> <p>LU-3 Erection and installation of Solar Panel</p> <p>LU-4 Interconnections of components and circuit diagrams</p>	4 Hours	44 Hours

	LU-5 Efficiency Measurement of solar system		
	LU-6 Series and parallel combinations of systems		
Module 5: Load Management Aim: This module covers the Load management techniques. The ways to reduce load efficiently and effectively. Different load types like AC and DC. Their wiring and connections.	LU-1 Load Reduction and deduction LU-2 Different arrangements assemblies for solar in DC and AC circuits. LU-3 Wiring involved in Solar system for both AC and DC circuits	3 Hours	12 Hours
Module 6: Troubleshooting Solar System Aim: This module covers the competencies required to inspect and test Solar System installations after completion of the installations. Locate faults systematically according to regulations/ standards, using specified test instruments & repair. Carryout periodic test and maintain reports for safe and optimum performance of the electrical installation, while ensuring safety of self, others and property.	LU-1 Inspection of a Solar system LU-2 Testing of solar system LU-3 Repair and maintenance of the solar system	3 Hours	12 Hours
Module 7: System Types Aim: This module covers the understanding of different types of Solar system used in the world. Difference between on grid, off grid system and stand alone system.	LU-1 Hand on experience for On-grid and Off-grid system including testing and connecting expertise LU-2 Stand alone and hybrid system, their advantages and disadvantages LU-3 Installation, Testing and Troubleshooting of Solar Systems	7 Hours	29 Hours
Module 8: Other Renewable Energies Aim: This module covers the understanding of other renewable energies that can be used to generate electricity other than solar energy. Their percentage usage in the world .	LU-1 Knowledge about the other sources of Renewable energies. LU-2 Their percentage contribution in the world	4 Hours	2 Hours

<p>Module 9: Entrepreneur</p> <p>Aim: This module cover the relationship that is necessary in the business, Find the coming up opportunities in the market and ways to generate finances</p>	<p>LU-1 Entrepreneurship.</p> <p>LU-2 Opportunity</p> <p>LU-3 Business Economics</p> <p>LU-4 Finance</p> <p>LU-5 Marketing Strategy</p>	<p>6 Hours</p>	
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Solar PV Training Curriculum Contents

Module 1 Title: Introduction To basic Electrical System

Objective of the Module:

Duration: Total: 24Hours , **Theory:** 14Hours , **Practical:** 10 Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Basic Electrical Terms and drawings	Identify the symbols used in the electrical drawings	<ul style="list-style-type: none"> • Knowledge about different symbols • Interpret different symbols used in the layout • Differentiate different symbols 	10Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	Class Room and work place both are used for learning.
	Knowledge about the basic Electrical Terms used in market	<ul style="list-style-type: none"> • Knowledge about basic electrical and electronic terms. • Understanding of electrical and electronic terms • Usage of electrical and electronic terms 			
	Knowledge about Electrical/Electronic Drawings	<ul style="list-style-type: none"> • Identify Electrical/electronic drawings • Interpret Electrical/electronic drawings • Drawing the Electrical/electronic drawings 			
LU-2 Electrical Measuring Instruments	Knowledge about the Types of Electrical Instruments used normally	<ul style="list-style-type: none"> • Identify the Type of instrument • Read the specifications/data sheet of the instrument 	8Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Wire cutter Wire Stripper Rubber gloves Screw Driver	Class Room and work place both are used for learning.
	Knowledge about how to use the Instruments	<ul style="list-style-type: none"> • Knowledge about which instrument to use • Knowledge about how to use instrument • Knowledge about where to use instrument 			
	Knowledge about the Precautions need to	<ul style="list-style-type: none"> • Identify the right instrument for the task 			

	use instruments	<ul style="list-style-type: none"> • Ensure the right connections of the Instruments • Repair and maintenance of the Instrument • insulation • gloves protection 			
LU-3 Precautions and safety	Precautions and safety before getting into work	<ul style="list-style-type: none"> • Tools are properly insulated • Circuit diagram is checked • Right fault is detected • ladder is properly insulated 	3Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Wire cutter Wire Stripper Rubber gloves	Class Room and work place both are used for learning.
	Precautions and safety after completing work	<ul style="list-style-type: none"> • Wires are properly Insulated • There is not any faulty/ loose connection • Describe the regulations for hazardous areas installations 			
LU-4 Wiring Standards and layouts	Ducting and piping	<ul style="list-style-type: none"> • Explain the operation of change over system. • Draw Block diagram of the change over system. • Interpret Schematic/circuit diagram of the change over system. • Install Standby power supply • Differentiate between star delta connections. • Demonstrate skill in cable termination. 	3Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Wire cutter Wire Stripper Rubber gloves Screw Driver Hammer Wires and Cables Color codes	Class Room and work place both are used for learning.
	Wiring for standby systems	<ul style="list-style-type: none"> • Determine the number and color of power cables and their route. • Draw block diagram of standby power Supply system. • Demonstrate installation Referring to Installation manuals of standby power system manuals 			
	Wiring main electrical circuit	<ul style="list-style-type: none"> • Describe the purpose of earthing. • Installing system according to lay out 			

		plan.			
	Wiring final circuit	<ul style="list-style-type: none"> • State the types of conductors. • Enlist types of insulators • Determine the AWG wire size with a wire gauge. • Calculate the cross-sectional area of conductors. • Select wire size as per required load • Demonstrate skill in interpreting wiring diagrams. • Carry out wiring according to lay out plan • Demonstrate the skills used for the stripping, • Demonstrate the skills used for Tagging • Demonstrate the skills used for terminating conductors. 			

Module 2 Title: Introduction to Basic PV system.

Objective of the Module:

Duration: Total: 15Hours , **Theory:**5Hours , **Practical:** 10Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Understanding of the components involved in solar system	Knowledge about Solar Panels	<ul style="list-style-type: none"> Types of Solar Panels Working of Solar Panels Demonstration about solar panel 	10Hours	Solar Panels Charge Controller Batteries Inverter	Class Room and work place both are used for learning.
	Knowledge about Solar Charge Controller	<ul style="list-style-type: none"> Types of Charge controllers Working of Charge controllers Demonstration about charge controller 			
	Knowledge about Batteries	<ul style="list-style-type: none"> Types of batteries Working of batteries Demonstration of batteries 			
	Knowledge about Inverter	<ul style="list-style-type: none"> Types of Inverters Working of Inverters Demonstration of inverter 			
LU-2 Learning Data sheets, Circuit diagrams, and other specifications of products	Read data sheets and Specifications	<ul style="list-style-type: none"> Identify the product through data sheet knowledge to read data sheet Demonstration to study the data sheet 	5Hours	Solar Panels Charge Controller Batteries Inverter Specifications and data sheets	Class Room and work place both are used for learning.

Module 3 Title: Feasibility and Designing of Solar PV system.

Objective of the Module:

Duration: Total: 30Hours , **Theory:**15Hours , **Practical:** 15Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Load analysis and Calculations for load.	What are the types of load	<ul style="list-style-type: none"> Types of Domestic load in shape of home appliances Types of Industrial Load in shape of machines 	6Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Wire cutter Wire Stripper Rubber gloves Screw Driver Product Specification sheet	Class Room and work place both are used for learning.
	How to calculate the load	<ul style="list-style-type: none"> Understanding the specification mentioned on the products Read the load using meters/Instruments Load calculations in single phase Load calculations in 3 phase 			
LU-2 Wiring Standards and layout for both AC and DC systems	Wiring standards	<ul style="list-style-type: none"> Types and sizes of wires available in market Selection of wire according to the calculated load 	3Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Wire cutter Wire Stripper Rubber gloves Screw Driver Product Specification sheet DC wires AC wires Connectors Jointer	Class Room and work place both are used for learning.
	Wiring For AC load	<ul style="list-style-type: none"> Chose the wire for the AC Load system Wiring of the AC load according to the layout diagram Precautionary measurement wile wiring Jointer/Connectors for DC wires 			
	Wiring For DC loads	<ul style="list-style-type: none"> Chose the wire for the DC Load system Wiring of the DC load according to the layout diagram Precautionary measurement wile wiring Jointer/Connectors for DC wires 			

				Breakers	
LU-3 Calculations for Components involved in Solar System	Identify the power Rating and quantity of Solar Panels	<ul style="list-style-type: none"> • Calculations to find the power needed in shape of Solar Panels • Calculation For the Quantity of solar panels needed to install 	6Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Product Specifications and data sheets	Class Room and work place both are used for learning.
	Identify the rating of Charge Controller	<ul style="list-style-type: none"> • Calculation for Voltages of charge controllers • Calculations for Amperes of Charge Controller 			
	Identify the rating for Inverter	<ul style="list-style-type: none"> • Calculation for Voltages of Inverter needed to install • Calculation for Amperes of Inverter • Calculation for W or VA of Inverter needed to install 			
	Identify the batteries rating required for the system	<ul style="list-style-type: none"> • Calculation For the Battery Backup Time • Calculation for Batteries Amperes • Calculation for Batteries Voltages 			
LU-4 Selection of components involved in Solar System	Identify the Feasible Solar Panel	<ul style="list-style-type: none"> • Type that fits according to the site and location. • Sizes that are feasible to install at the location and site 	15Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Product Specification sheet	Class Room and work place both are used for learning.
	Identify the Feasible Charge Controller	<ul style="list-style-type: none"> • Type of the Charge controller best to utilize • Quantities or number according to the requirement or standards 			
	Identify the Feasible Inverter	<ul style="list-style-type: none"> • Type of inverter best for the location • Quantities that can be installed for the safety of system 			
	Identify the Feasible Batteries	<ul style="list-style-type: none"> • Type of Battery that is best according to the required system • Quantity and number that can be adjusted according to the location, safety and reliability of the system. 			

Module 4 Title: Installation Of Solar PV system.

Objective of the Module:

Duration: Total: 48Hours , **Theory:**4Hours , **Practical:** 44Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Solar System being used in the world.	Understanding of the types and way of Solar PV systems being used in the world	<ul style="list-style-type: none"> Places where Solar PV systems are used The way the other countries install the system The way other countries design and manage the system 	1Hour		Class Room is used for learning.
LU-2 Orientation of Solar Panel	Locate the right Direction to install Solar panel	<ul style="list-style-type: none"> Locate the sun direction with the use of compass Locate the shading points and remove them Use the irradiation meter to find the best possible outcome 	3Hours	Electrician's tool kit Radiance meter compass	Class Room and work place both are used for learning.
	Give the right tilt to the Solar Panel	<ul style="list-style-type: none"> Amount of tilt needed according to the location Use the irradiation meter to find the best possible outcome 			
LU-3 Erection and installation of Solar Panel	Erection of Stand for solar panel	<ul style="list-style-type: none"> Direction of stand according to the sun direction Tilt of the stand according to the sun tilt Select the material type of the stand <ul style="list-style-type: none"> Iron Aluminum Steel Select the type of stand <ul style="list-style-type: none"> Tracking stand Fixed Stand Installation of Stand 	10Hours	Electrician's tool kit Radiance meter compass ranch Drill Machine Iron Cutter plier nose plier straight Grease box	Work place is used for learning.

		<ul style="list-style-type: none"> • Rowel-bolts • Foundation • Use of Greased Nut bolts 			
	Fixing of solar panel on stand	<ul style="list-style-type: none"> • Solar panel orientation according to the stand and sun • Solar panel tilt according to the stand and sun tilt • Path for the air between the panels • Wind pressure that will exert pressure on the panel • Type of bolts used to fix the solar panel • Use of Greased Nut bolts 			
	Disassembling Of solar panels	<ul style="list-style-type: none"> • Grease or oil the nut bolts • Open the nuts of solar panel without damaging it 			
	Disassembling of Solar stand	<ul style="list-style-type: none"> • Grease or oil the nut bolts • Open the nuts of Panel Stand while keeping the record of their original sites • Follow the steps of disassembling of Panel stand 			
LU-4 Interconnections of components and circuit diagrams	Connections of batteries	<ul style="list-style-type: none"> • Batteries Specifications and rating • Batteries Terminals polarity and their cleaning • Wire feasible for the batteries connections. • Types of batteries thimbles • Types of wire connectors for batteries 	10Hours	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet	Class Room and work place both are used for learning.
	Connections of Charge Controller	<ul style="list-style-type: none"> • Charge controller terminals drawing and specifications • Types of wire connectors for Charge Controller • Charge controller terminals and their 		Electrician's tool kit Radiance meter compass ranch	

		<ul style="list-style-type: none"> connections stepwise Setting parameters of Charge Controller (If Needed) 		<ul style="list-style-type: none"> Drill Machine Iron Cutter plier nose plier straight Grease box Battery Thimbles Wire Connectors Solar Panel Connectors 	
	Connections of Solar Panel	<ul style="list-style-type: none"> Solar Panel specifications and rating Solar Panel Terminals polarity and their cleaning Wire feasible for the Solar Panel connections. Types of wire connectors for Solar Panel Types of Solar Panel connectors Types of wire connectors for Charge controller Solar Panel connections stepwise 			
	Connections of Inverter	<ul style="list-style-type: none"> Inverter terminals drawing and specifications Types of wire connectors for Inverter Inverter terminals and their connections stepwise Setting parameters of Inverter (If Needed) 			
LU-5 Efficiency Measurement of solar system	Check Efficiency of Solar Panel	<ul style="list-style-type: none"> Find the radiance using radiance meter Output /Input of the Solar Panel Eliminate the shadowing effect 	11Hours	<ul style="list-style-type: none"> Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet 	Class Room and work place both are used for learning.
	Check Efficiency of Charge Controller	<ul style="list-style-type: none"> Output /Input of the Charge Controller Are Parameters set accordingly (If Needed) 		Electrician's tool kit	
	Check Efficiency of Inverter	<ul style="list-style-type: none"> Output /Input of the Inverter Are Parameters set accordingly (If Needed) 		<ul style="list-style-type: none"> Radiance meter compass plier nose plier straight Battery Thimbles Wire Connectors Solar Panel 	
	Check Efficiency of Batteries	<ul style="list-style-type: none"> Backup Time according to the standard backup time. Age of the batteries 			

		<ul style="list-style-type: none"> Voltage level and charging level of batteries 		Connectors Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	
LU-6 Series and parallel combinations of systems	Connections of Solar Panels	<ul style="list-style-type: none"> Calculations of Solar panels Amperes and voltages needed. Selection of solar panel Arrays to achieve the targeted voltages and amperes 	13Hours	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet	Class Room and work place both are used for learning.
	Connections of Charge Controller	<ul style="list-style-type: none"> Calculations of Charge Controller Amperes and voltages needed. Selection of charge controller Sets of charge controller needed according to the feasibility and safety of system 		Electrician's tool kit	
	Connections of Inverter	<ul style="list-style-type: none"> Calculations of Inverter Amperes and voltages needed. Selection of Inverter Sets of Inverter needed according to the feasibility and safety of system 		Radiance meter compass ranch Drill Machine Iron Cutter plier nose plier straight Battery Thimbles Wire Connectors Solar Panel Connectors	
	Connections of Batteries	<ul style="list-style-type: none"> Calculations of Batteries Backup time needed Amperes and voltages needed. Selection of Batteries Arrays to achieve the targeted need 		Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	

Module 5 Title: Load Management.

Objective of the Module:

Duration: Total: 15Hours , **Theory:** 3Hours , **Practical:** 12Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Load Reduction and deduction	Reducing load	<ul style="list-style-type: none"> Remove the unnecessary loads from the solar appliances list Change the high amperes with low amperes devices 	4Hours	Led lights Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	Class Room and work place both are used for learning.
LU-2 Different arrangements assemblies for solar in DC and AC circuits.	Appliances for the DC system	<ul style="list-style-type: none"> Specifications of the DC appliances Polarity of the devices Parallel and series combinations on devices Efficiency of the devices 	6Hours	LED Street Light LED bulb Specification and data sheet Electrician's tool kit	Class Room and work place both are used for learning.
	Appliances for the AC system	<ul style="list-style-type: none"> Specifications of the AC appliances Efficiency of the devices Single phase and three phase appliances 		Plier nose Plier straight Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	
LU-3 Wiring involved in Solar system for both AC and DC circuits	Wiring for the DC system	<ul style="list-style-type: none"> Wire requirement for the devices according to the specification Wiring of the Devices according to the standards Piping and ducting 	5Hours	Electrician's tool kit Drill Machine Iron Cutter hammer	Class Room and work place both are used for learning.

	Wiring for the AC system	<ul style="list-style-type: none"> • Wire requirement for the devices according to the specification • Wiring of the Devices according to the standards • Piping and ducting • Single phase and three phase wiring 	<ul style="list-style-type: none"> plier nose plier straight Battery Thimbles Wire Connectors Solar Panel Connectors Voltage Tester Duct Pipe Wires 6mm,3mm,2.5mm 	
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Module 6 Title: Troubleshooting Solar System

Objective of the Module:

Duration: Total: 15Hours , **Theory:** 3Hours , **Practical:** 12Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Inspection of a Solar system	Check the installation visually for general compliance with the standards & regulations and referring to lay out plans.	<ul style="list-style-type: none"> • Demonstrate skills in interpreting layout drawings. • Explain characteristics of a proper installation. • Prepare inspection report on prescribed Performa. 	5Hour	Electrician’s tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	Class Room and work place both are used for learning.
	Inspect the Solar System installations for defects and damages.	<ul style="list-style-type: none"> • Describe the Possible defects in Solar System installations. • Identify defective Parts. 			
	Check Protective devices and accessories for damages	<ul style="list-style-type: none"> • Describe different types of protective devices and their use in protection circuits. • Identify deviations from the layout plan 			
LU-2 Testing of solar system	Carry out the tests using specified electrical test instrument in conformity with regulations and standards and observing safety precautions	<ul style="list-style-type: none"> • Perform following tests: <ul style="list-style-type: none"> • Orientation and tilt of panels • Panels Polarity • Batteries Polarity • Connection sequence • Phase sequence • Prospective over current/ short circuit current & voltage. 	5Hour	Circuit Diagram Specifications and data sheet Electrician’s tool kit Radiance Meter Compass Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	Class Room and work place both are used for learning.
	Test the installation for its working, locate faults and	<ul style="list-style-type: none"> • Describe the information deduct from above tests. • Prepare report on prescribed 			

	note down & prepare reports.	Performa.		Breakers Fuses	
LU-3 Repair and maintenance of the solar system	Enlist the Necessary adjustments needed to check the Solar system.	<ul style="list-style-type: none"> Describe common type of faults and their remedy 	5Hour	Circuit Diagram Specifications and data sheet	Class Room and work place both are used for learning.
	Prepare list of items/material required for replacement and obtain them.	<ul style="list-style-type: none"> Describe types of accessories and their application on installations. 		Electrician's tool kit	
	Service/Repair/ replace defective Parts damaged wire/ cable, damaged / defective fixtures/fittings electrical accessories.	<ul style="list-style-type: none"> Describe operation of different types of components that may be used in solar system Demonstrate skills in repairing for assigned task 		Radiance Meter Compass Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	
	Repair / or replace Electrical supply.	<ul style="list-style-type: none"> Explain types of wires and accessories used in supply system 			

Module 7 Title: System Types

Objective of the Module:

Duration: Total: 36Hours , **Theory:** 7Hours , **Practical:** 29Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Hand on experience for On-grid and Off-grid system including testing and connecting expertise	Installation of Off-Grid system	<ul style="list-style-type: none"> Types in off-grid inverters Installation of off-grid inverters Solar Panel Orientation and tilt Connections of the solar panel, charge controller, batteries and inverters 	11Hour	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet	Class Room and work place both are used for learning.
	Installation of On-Grid system	<ul style="list-style-type: none"> Types in on grid inverters Installation review of on grid inverters Solar Panel Orientation and tilt Connections of the solar panel, charge controller, batteries and inverters 		Electrician's tool kit Radiance meter compass ranch Drill Machine Iron Cutter plier nose plier straight Battery Thimbles Wire Connectors Solar Panel Connectors Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	
LU-2 Stand alone and hybrid system,	Installation of Stand alone system	<ul style="list-style-type: none"> Types in stand alone and hybrid inverters Installation of stand alone and hybrid inverters 	13Hour	Batteries Charge Controller Solar Panel Inverter	Class Room and work place both are used for learning.

their advantages and disadvantages		<ul style="list-style-type: none"> • Solar Panel Orientation and tilt • Connections of the solar panel, charge controller, batteries and inverters 		Specifications and data-sheet Electrician's tool kit	
	Installation of Hybrid	<ul style="list-style-type: none"> • Types in stand alone and hybrid inverters • Installation of stand alone and hybrid inverters • Solar Panel Orientation and tilt • Connections of the solar panel, charge controller, batteries and UPS 		Radiance meter compass ranch Drill Machine Iron Cutter plier nose plier straight Battery Thimbles Wire Connectors Solar Panel Connectors Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	
LU-3 Installation, Testing and Troubleshooting of Solar Systems	Troubleshooting in hybrid system	<ul style="list-style-type: none"> • Inspection of Solar System • Testing of Solar System • Repair of Solar System 	12Hour	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet Electrician's tool kit	Class Room and work place both are used for learning.
	Troubleshooting in Stand alone System	<ul style="list-style-type: none"> • Inspection of Solar System • Testing of Solar System • Repair of Solar System 			
	Troubleshooting in off grid System	<ul style="list-style-type: none"> • Inspection of Solar System • Testing of Solar System • Repair of Solar System 			
				Radiance meter compass ranch Drill Machine Iron Cutter plier nose	

				plier straight Battery Thimbles Wire Connectors Solar Panel Connectors Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	
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Module 8 Title: Other Renewable Energies

Objective of the Module:

Duration: Total: 6Hours , **Theory:** 4Hours , **Practical:** 2Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Knowledge about the other sources of Renewable energies.	Solar Thermal	<ul style="list-style-type: none"> Knowledge and understanding of Solar Thermal 	5Hours	Thermal Geyser Wind Turbine Specifications and data-sheet	Class Room and work place both are used for learning.
	Wind Energy	<ul style="list-style-type: none"> Knowledge and understanding of Wind turbine 			
	Geo thermal, Bio Gas, Tidle, Hydrogen Fuel cell, photosynthesis	<ul style="list-style-type: none"> Knowledge and understanding of renewable energies that can be used to generate electricity 			
LU-2 Their percentage contribution in the world	Contribution of different types of renewable energies		1Hour		Class Room is used for learning.

Module 9 Title: Entrepreneur

Objective of the Module:

Duration: Total: 6Hours , **Theory:** 6Hours , **Practical:** 0Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
LU-1 Entrepreneurship	To deliver key difference between the thinking of an employee and an employer	<ul style="list-style-type: none"> • What is an Entrepreneurial Mindset? • The Entrepreneurial Process <p>- What is the key difference in the thinking of an entrepreneur. How is he willing to take calculated risks considering the situation in the market. How does he identifies worthy opportunities in the market.</p>	1		Class Room is used for learning.
LU-2 Opportunity	To identify opportunity and act accordingly	<ul style="list-style-type: none"> • Defining Opportunity - what is the basic concept of opportunity. How a worthy opportunity is identified. • An Opportunity is Different from a Business Concept - Opportunity arises when there is a need whereas a business concept is what is the business about. • Sources and Types of Opportunity - Understanding the market and the customer need. 	1		Class Room is used for learning.
LU-3 Business Economics	Charge clients according to the costs incurred and services provided	<ul style="list-style-type: none"> • Types of Costs; Break-even Analysis - fixed cost, variable cost, how to calculate break-even in a venture and explain how to extract money. 	1		Class Room is used for learning.
LU-4 Finance	Generate finances for the business	<ul style="list-style-type: none"> • Sources of Finance - How to generate financing for the business venture. Sources include; Angel financing, from relatives, from 	1		Class Room is used for learning.

		<p>banks, from NPO supporting the cause, Partnership.</p> <ul style="list-style-type: none"> - Criteria Used by Different Sources of Finance <p>Requirements of financing institutes such as SMEDA, Banks etc. Required Documentation.</p>			
LU-5 Marketing Strategy	How to attract clients to buy a services. How to create distinction in the market.	<ul style="list-style-type: none"> • How Marketing Evolves in Start-up Firms <ul style="list-style-type: none"> - Initial marketing practices. May include brochures, sign boards, standees, newspaper. • Product Strategies <ul style="list-style-type: none"> - suggesting feasible and relevant products to customers, • Setting Your Prices <ul style="list-style-type: none"> - how to set prices of services and products provided. Low cost strategies, high quality strategy, low cost/ high quality strategy. • Crafting a Communications Approach <ul style="list-style-type: none"> - Convincing strategies, aimed at sales of product. • Setting Up Distribution <ul style="list-style-type: none"> - making deals with existing companies to win their products for distribution in market. 	2		Class Room is used for learning.

Solar PV Training Curriculum Assessment

Module 1 Title: Introduction To basic Electrical System

Objective of the Module:

Duration: Total: 24Hours , **Theory:** 14Hours , **Practical:** 10 Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Basic Electrical Terms and drawings	8Hours	2Hours	<ul style="list-style-type: none"> • Define Solar Energy • Type of electricity Solar panel producing • Difference between AC and DC current and voltages • What is ohms law • What is frequency • Which frequency is used in Pakistan. • Differentiate Watt and VA • Define is Wh • Define voltage drop • Define peak load • Differentiate Vrms and Vavg • Explain KCL and KVL • Demonstrate conversion from wattage to VA 	Paper based Test Oral Demonstration	
LU-2 Electrical Measuring Instruments	3Hours	5Hours	<ul style="list-style-type: none"> • List types of measuring instruments • Demonstrate how to measure wattage from watt meter • Demonstrate how to find load of certain appliance • Types of instrument to measure wattage • Demonstrate how to measure watt • Demonstrate how to measure current from an ammeter. 	Paper based Test Oral Demonstration	
LU-3 Precautions and safety	2Hours	1Hours	<ul style="list-style-type: none"> • list any 5 precautionary measures while working with electricity • Occupational Health and safety. 	Paper based Test Oral Demonstration	

LU-4 Wiring Standards and layouts	1Hours	2Hours	<ul style="list-style-type: none"> • Effect of joints on wire • list Classification of wires • Types of connectors in daily life • Demonstrate cable gauge against given load • Name the tools used in chipping. • Identify the tools used for chipping. • Demonstrate skills in making threads. • Demonstrate skills in cutting conduits. • Demonstrate skills to ensuring the firmness of • conduit. • Select the appropriate accessories used in fixing conduits. • Explain the use of transformer • Differentiate between star delta connections. • Demonstrate skill in cable termination. • Describe the purpose of earthing. 	Paper based Test Oral Demonstration	
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Supportive notes

Assessment context

- This module could be assessed on or off the job or in a simulated situation
- Candidate must demonstrate the competencies in this unit individually
- This unit could be assessed individually or in conjunction with other related units.
- In this unit preparation of estimates are limited to the following:
 - Domestic/Industrial electrical new installations.
 - Repairs/alterations/additions to existing domestic/ industrial electrical installations, Single and 3-phase.

Critical aspects

Assessment must confirm the candidate's ability to:

- Understand the basic formulas of Electrical/Electronics.
- Measuring Techniques and instruments.
- Precautions before and while Electrical working
- Wiring Standards and types.

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant Instruments. .

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 2 Title: Introduction to Basic PV system.

Objective of the Module:

Duration: Total: 15Hours , **Theory:**5Hours , **Practical:** 10Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Understanding of the components involved in solar system	3Hours	7Hours	<ul style="list-style-type: none"> • Define sun energy • what is the tilt degree of earth • List types of Solar panels • List types of dry batteries • Voltage of single cell • Differentiate between MPPT and PWM • Nominal voltages of different panels • Explain short circuit current and open circuit voltages • Define purpose of solar Charge Controllers • Sun direction during rising • Ideal direction of solar panel • Differentiate between isolation and irradiation • Differentiate UPS and Inverter • Radiance meter • Define shade effect • Purpose of battery indicator • Maximum discharge rate of battery • Modified and pure-sine wave inverters • How to look for the specifications of any product • What is data sheet 	Paper based Test Oral Demonstration	
LU-2 Learning Data sheets, Circuit diagrams, and other specifications of products	2Hours	3Hours	<ul style="list-style-type: none"> • Interpret symbols used in a layout plan. • Differentiate between different views in a drawing. • Interpret given lay out plan. • Draw Block diagram of the change over system. • Interpret Schematic/circuit diagram of the change over system. 	Paper based Test Oral Demonstration	

Supportive notes

Assessment context

- This module could be assessed on or off the job or in a simulated situation
- Candidate must demonstrate the competencies in this unit individually
- This unit could be assessed individually or in conjunction with other related units.
- In this unit preparation of estimates are limited to the following:
 - Domestic/Industrial Solar PV related installations.
 - Testing, reading data sheets and specifications of components
 - Reading and designing circuit diagrams

Critical aspects

Assessment must confirm the candidate's ability to:

- Understand the Electrical drawings
- Understand the use of data-sheets and user manuals.
- Must know about the components involved in solar system.

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related Instruments

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 3 Title: Feasibility and Designing of Solar PV system.

Objective of the Module:

Duration: Total: 30Hours , **Theory:**15Hours , **Practical:** 15Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Load analysis and Calculations for load.	4Hours	2Hours	<ul style="list-style-type: none"> List major components involved in AC and DC systematically List any 5 common load in house Calculate the total load of given appliances what is best inverter for load provided Find amperes of the given load 	Paper based Test Oral	
LU-2 Wiring Standards and layout for both AC and DC systems	2Hours	1Hours	<ul style="list-style-type: none"> Write the gauge of the wire for the given load Calculate the load for the given wire gauge list down the types of cables used for electrification 	Paper based Test Oral Demonstration	
LU-3 Calculations for Components involved in Solar System	4Hours	2Hours	<ul style="list-style-type: none"> Inverter specification for the given load Suggest the battery for given load Suggest the battery for 10 hour backup at given load What would be the wattage of solar panels Calculate the charge controller rating for given system 	Paper based Test Oral	
LU-4 Selection of components involved in Solar System	5Hours	10Hours	<ul style="list-style-type: none"> Calculate the load of appliances list. Calculate its backup for 6 hours, And also suggest the solar panels What is the method to select the best device for the system 	Paper based Test Oral Demonstration	

Supportive notes

Assessment context

- This module could be assessed on or off the job or in a simulated situation
- Candidate must demonstrate the competencies in this unit individually
- This unit could be assessed individually or in conjunction with other related units.
- In this unit preparation of estimates are limited to the following:
 - Domestic/Industrial Solar PV related installations.
 - Analysis of Domestic/Industrial Load
 - Calculations related solar system according to the analyzed load
 - Selection of the equipment according to the calculated Solar system

Critical aspects

Assessment must confirm the candidate's ability to:

- Understand the load requirements Domestic/Industrial
- Understand the calculations to find the load
- Knowledge about instruments to calculate load
- Understand the use of data-sheets, user manuals and given specifications.
- Must know about the components involved in solar system.
- Depth knowledge about calculations to find the feasible solar system.
- Understand the calculations to fine the best Equipment for solar system.

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related devices

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 4 Title: Installation Of Solar PV system.

Objective of the Module:

Duration: Total: 48Hours , **Theory:**4Hours , **Practical:** 44Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Solar System being used in the world.	1Hours		<ul style="list-style-type: none"> • Which biggest solar using countries • Which are the new emerging solar using countries • what are solar farms 	Paper based Test Oral	
LU-2 Orientation of Solar Panel		3Hours	<ul style="list-style-type: none"> • Orientation of panels must be in the direction • what are the best methods to find mid direction of sun • What is compass • Define shading • What is radiance meter and how its work • What is the tilt angle 	Paper based Test Oral Demonstration	
LU-3 Erection and installation of Solar Panel		10Hours	<ul style="list-style-type: none"> • what are the few things that must be kept in mind before installing the frame • What type of panel stand is best for solar panel • What are the types of stand • Which stand material is commonly used • What are the things that must be consider before disassembling solar panels 	Oral Demonstration	
LU-4 Interconnections of components and circuit diagrams	1Hours	9Hours	<ul style="list-style-type: none"> • Justify the use of inverter in solar system • Before connecting batteries what must be kept in mind • what are the three types of battery thimbles • Types of connectors for charge controller • what are the steps to connects charge controller • Why do we set the parameters • What are the connectors use to inter connect the Solar Panels • What are the steps to connect the solar panel 	Oral Demonstration	

			<ul style="list-style-type: none"> with charge controller Types of connectors used to connect inverter What are the main steps to connect the inverter to the battery 		
LU-5 Efficiency Measurement of solar system	1Hours	10Hours	<ul style="list-style-type: none"> Define Efficiency Describe the testing method of solar panel How to test the efficiency of the solar panel Calculate the efficiency of charge controller at given scenario Find the percentage deviation of inverter efficiency from the provided data sheet How to check the charging level of batteries Calculate the efficiency of battery according to the specification and practical scenario 	Paper based Test Oral Demonstration	
LU-6 Series and parallel combinations of systems	1Hours	12Hours	<ul style="list-style-type: none"> Demonstrate the installation of solar system What would be the outcome of panels connected in series of said specification Calculate the solar panel needed for the given load Draw the design of best possible Solar Panel array How to determine weather we must use one controller or two How to select the inverter if you don't have any specifications or data sheet of the equipment According to the given load and available batteries range design the best possible array combination. 	Paper based Test Oral Demonstration	

Supportive notes

Assessment context

- This module could be assessed on the job or in a simulated environment demonstrated by an individual working alone or as a part of a team.
- This unit could be assessed individually or in conjunction with other related units.
- Work may take place in a LAB or in open site where the technician is called to perform the job.
- In this unit preparation of estimates are limited to the following:
 - Right Orientation and tilt angle of Solar panel
 - Erection of panel stand
 - Connections between Solar System devices
 - Series and parallel Combinations designing solar system.
 - Testing and measuring Efficiency of components

Critical aspects

Assessment must confirm the candidate's ability to:

- Find the right direction and tilt angle at site.
- Efficiently Erect the panel stand and capable of designing the simple panel stand.
- Understand clearly how and where to connect the solar devices.
- Make the parallel and series combinations efficiently.
- Measure all tests and take readings effectively.

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access tools like cutter, caliper, stripper, etc
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related devices
- Data sheets, User manual and specifications

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 5 Title: Load Management.

Objective of the Module:

Duration: Total: 15Hours , **Theory:** 3Hours , **Practical:** 12Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Load Reduction and deduction	1Hours	3Hours	<ul style="list-style-type: none"> • What is load reduction • What will you suggest to customer for load reduction in given scenario • What are some methods to reduce the load 	Paper based Test Oral Demonstration	
LU-2 Different arrangements assemblies for solar in DC and AC circuits.	1Hours	5Hours	<ul style="list-style-type: none"> • Why DC appliances are more favorable for solar system. • How to measure the efficiency of DC appliances. • How can you find the actual rating of the AC appliances. • What is the difference between single phase and 3 Phase devices • How to calculate the comparison of WAPDA and Solar. 	Paper based Test Oral Demonstration	
LU-3 Wiring involved in Solar system for both AC and DC circuits	1Hours	4Hours	<ul style="list-style-type: none"> • What should be the gauge of wire for given rating • How many wires are involved in 3 phase load • how many wires are connected with star connected motor • what are the common color codes • How to detect the neutral wire of motor if coding is not available 	Paper based Test Oral Demonstration	

Supportive notes

Assessment context

- This module could be assessed on the job or in a simulated environment demonstrated by an individual working alone or as a part of a team.
- This unit could be assessed individually or in conjunction with other related units.
- Work may take place in a LAB or in open site where the technician is called to perform the job.
- In this unit preparation of estimates are limited to the following:
 - Load Estimation
 - Reduction and deduction from the load
 - DC and AC Wiring
 - DC and AC appliances installations
 - Connections for single phase and 3 phase
 - Comparison of WAPDA with solar

Critical aspects

Assessment must confirm the candidate's ability to:

- Reduce the load
- Deduct the less important devices
- Understand the difference between DC and AC devices
- Understand the difference between DC and AC Wiring
- Make DC and AC connections easily.

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access tools like cutter, caliper, stripper, etc
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related devices
- Data sheets, User manual and specifications

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 6 Title: Troubleshooting Solar System

Objective of the Module:

Duration: Total: 15Hours , **Theory:** 3Hours , **Practical:** 12Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Inspection of a Solar system	1Hours	4Hours	<ul style="list-style-type: none"> • Define troubleshooting • What if the Solar system stops giving output • Describe user manual • Demonstrate skills in interpreting layout drawings. • Explain characteristics of a proper installation. • Prepare inspection report on prescribed Performa. • Describe possible defects in Solar System installations. • Identify defective Parts. • Report the damages. Describe different types of protective devices and their use in protection circuits. • Identify deviations from the layout plan • What is user training manual • Purpose of data sheet 	Paper based Test Oral Demonstration	
LU-2 Testing of solar system	1Hours	4Hours	<ul style="list-style-type: none"> • List down the reasons of batteries explosions • Explain what is blocking diode • Charge controller supports which type of voltages • What if selection of equipments goes away from the slandered/calculations • Write down the connections of solar system step wise • Describe the information deducted from tests. • Prepare report on prescribed Performa. <p>Perform following tests:</p> <ul style="list-style-type: none"> • Conductor continuity 	Paper based Test Oral Demonstration	

			<ul style="list-style-type: none"> • Polarity Phase sequence Prospective over current/ short circuit current & voltage. 		
LU-3 Repair and maintenance of the solar system	1Hours	4Hours	<ul style="list-style-type: none"> • Describe common type of faults and their remedies. • Demonstrate skills in repairing for assigned task • How to remove shadow effect • What are the Electrical safety Devices • Differentiate Breaker and fuse • List the indoor devices in solar system • State ideal charging rate of a battery • It is best to connect DC load with 	Paper based Test Oral Demonstration	

Supportive notes

Assessment context

- This module could be assessed on the job or in a simulated environment demonstrated by an individual working alone or as a part of a team.
- This unit could be assessed individually or in conjunction with other related units.
- Work may take place in a LAB or in open site where the technician is called to perform the job.
- In this unit preparation of estimates are limited to the following:
 - Inspection related to solar system
 - Testing standards of Solar System
 - Repair and maintenance related Solar System

Critical aspects

Assessment must confirm the candidate's ability to:

- Inspect the Solar system
- Find the fault in the system
- Examine the main cause of fault
- Suggest the solution
- Repair and maintain the working of Solar System

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access tools like cutter, caliper, stripper, etc
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related devices
- Data sheets, User manual and specifications

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 7 Title: System Types**Objective of the Module:****Duration: Total:** 36Hours , **Theory:** 7Hours , **Practical:** 29Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Hand on experience for On-grid and Off-grid system including testing and connecting expertise	2Hours	9Hours	<ul style="list-style-type: none"> • What is the difference between On-grid and off grid inverter • What is the difference between on-grid and off-grid systems • Write some examples of off grid • Design an off-grid system 	Paper based Test Oral Demonstration	
LU-2 Stand alone and hybrid system, their advantages and disadvantages	2Hours	11Hours	<ul style="list-style-type: none"> • Differentiate between hybrid and stand alone system • Design a stand alone system for the given load • Write own the advantages and disadvantages of hybrid system • What is solar Tube-well • Write the advantages of Solar Tube-well reference to peter engine 	Paper based Test Oral Demonstration	
LU-3 Testing and Troubleshooting of Solar Systems	3Hours	9Hours	<ul style="list-style-type: none"> • What must be the tilt angle of the panel stands • What must be the orientation of solar panel and how it will be detected • what are the basic steps to install on-grid inverter • Draw a diagram showing the connections of Stand alone system with given data • what are the steps to test the stand alone system • Write the steps to trouble shoot inverter 	Paper based Test Oral Demonstration	

Supportive notes

Assessment context

- This module could be assessed on the job or in a simulated environment demonstrated by an individual working alone or as a part of a team.
- This unit could be assessed individually or in conjunction with other related units.
- Work may take place in a LAB or in open site where the technician is called to perform the job.
- In this unit preparation of estimates are limited to the following:
 - On-Grid and Off-Grid systems
 - Stand Alone and Hybrid systems
 - Testing standards of Solar System
 - Repair and maintenance related Solar System

Critical aspects

Assessment must confirm the candidate's ability to:

- Understanding About On-Grid And Off- Grid Systems
- Knowledge about installation of On-Grid And Off- Grid Systems
- Understanding about Stand Alone and Hybrid Systems
- Knowledge about installation of Stand Alone and Hybrid Systems
- Inspect the Solar system
- Find the fault in the system
- Examine the main cause of fault
- Suggest the solution and repair the Solar System

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access tools like cutter, caliper, stripper, etc
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related devices
- Data sheets, User manual and specifications

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

Module 8 Title: Other Renewable Energies

Objective of the Module:

Duration: Total: 6Hours , **Theory:** 4Hours , **Practical:** 2Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
LU-1 Knowledge about the other sources of Renewable energies.	3Hours	2Hours	<ul style="list-style-type: none">• Define Wind Energy• Explain Wind Turbine• What is Solar Thermal• What are the ways to use it• Explain Briefly Bio-Gas, Geo Thermal and Fuel Cell	Paper based Test Oral Demonstration	
LU-2 Their percentage contribution in the world	1Hours				

Supportive notes

Assessment context

- This module could be assessed on the job or in a simulated environment demonstrated by an individual working alone or as a part of a team.
- This unit could be assessed individually or in conjunction with other related units.
- Work may take place in a LAB or in open site where the technician is called to perform the job.
- In this unit preparation of estimates are limited to the following:
 - Wind Energy
 - Solar Thermal
 - Other Renewable Energies

Critical aspects

Assessment must confirm the candidate's ability to:

- Basic Understanding About Renewable energies other than Solar PV System mainly focused on Wind and Solar Thermal.

Assessment condition

The candidate will have access to:

- Access Commonly Available instruments.
- Access tools like cutter, caliper, stripper, etc
- Access to Solar related devices
- Stationary and documentary material required.

The candidate will be permitted to refer to the following documents:

- Relevant measuring Instruments. .
- Solar related devices
- Data sheets, User manual and specifications

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessors.
- Assessors must be satisfied that the candidate can competently perform all elements of the unit as specified by the criteria, and that he / she possess the required underpinning knowledge.

Resources required for assessment

- All tools and stationary and relevant information/ data

List of tools Equipment/Tools

Ser	Name of tools /equipment	Quantity
1	Mono Panel 40W	28
2	Poly Panel 147W	7
3	Poly Panel 250W	4
4	Thin Film 135W	8
5	Building Integrated Photovoltaic 180W	2
6	Building Integrated Photovoltaic 160W Glass	1
7	Battery: Sealed 24Ah	8
8	Battery: Sealed 200Ah	2
9	Battery: Sealed 200Ah	4
10	Battery: Sealed 150Ah	4
11	Charge Controller: MPPT 10A/12V	4
12	Inverters: Grid Connected 1200W	1
13	Inverters: Grid Connected 2000W	1
14	Inverters: Off Grid 500W	2
15	Inverters: Hybrid Inverter 2kVA	1
16	Inverters: Hybrid Inverter 1kVA	2
17	Inverters: Hybrid Inverter 500W	2
18	DC Cables 4mm,6mm	360m
19	AC Cables 4mm,6mm	120m
20	Digital clamp meter Fluk 319	4
21	Cable cutter 8 inch	8
22	Wire stripper	8
23	Crimping Plier	8

24	Analog Volt Meter AC	4
25	Analog Ampere meter AC	4
26	Analog Ampere meter DC	4
27	Watt Meter	1
28	Energy meter single phase digital	1
29	Battery tester	4
30	Line Splitter	4
31	DR Set	2
32	Screw driver set 7pcs	4
33	Nose plier 6 inch	4
34	Flat nose plier	4
35	Hammer	4
36	Blade Cutter	4
37	Inches tape	2
38	Ranch	4
39	Soldering iron	1
40	Soldering wire roll 100gm	2
41	Soldering paste	1
42	Voltage detector AC	4
43	Magnetic Breakers 2 Pole 20A	4
44	Magnetic Breakers 2 Pole 30A	4
45	Magnetic Breakers 2 Pole 40A	4
46	Insulating Gloves	30
47	Safety helmet	30
48	Safety Glasses	30
49	Power meter	1
50	Hand Held Oscilloscope 10 MHz	1

51	Drill Machine	2
52	Pipe Cutter	4
53	Ratchet Die	4
54	Solar Irradiance meter	4
55	Solar Cells 3W	10
56	MC3 Connectors	8
57	MC4 Connectors	8
58	Battery Thimble	16
59	Compass	8
60	Tool kit Bag	8