

# **Solar Photovoltaic Installation and Pumping Training**

**Curriculum  
Certificate level – 3 Months**



## Table of Contents

### Overview about the program

Module title and aim	Learning units	Theory hours	Workplace hours
<b>Module 1: Introduction to Basic Electrical system.</b>  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.	LU-1 Basic Electrical Terms and drawings LU-2 Electrical Measuring Instruments LU-3 Precautions and safety LU-4 Wiring Standards and layouts	14 Hours	10 Hours
<b>Module 2: Introduction to Basic PV system.</b>  Aim: This module covers the basic understanding of PV system and the components that are involved in the solar system.	LU-1 Understanding of the components involved in solar system LU-2 Learning Data sheets, Circuit diagrams, and other specifications of products	5 Hours	10 Hours
<b>Module 3: Feasibility and Designing of Solar PV system.</b>  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.	LU-1 Load analysis and Calculations for load. LU-2 Wiring Standards and layout for both AC and DC systems LU-3 Calculations for Components involved in Solar System LU-4 Selection of components involved in Solar System	15 Hours	15 Hours
<b>Module 4: Installation Of Solar PV system.</b>  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.	LU-1 Solar System being used in the world. LU-2 Orientation of Solar Panel LU-3 Erection and installation of Solar Panel LU-4 Interconnections of components and circuit diagrams LU-5 Efficiency Measurement of solar system LU-6 Series and parallel combinations of systems	4 Hours	44 Hours

<b>Module 5: Load Management</b>  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
<b>Module 6: Troubleshooting Solar System</b>  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
<b>Module 7: System Types</b>  Aim: This module covers the understanding of different types of Solar system used in the world. Difference between on grid, off grid system and standalone 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
<b>Module 8: Other Renewable Energies</b>  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
<b>Module 9: Entrepreneur</b>  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	LU-1 Entrepreneurship. LU-2 Opportunity LU-3 Business Economics LU-4 Finance LU-5 Marketing Strategy	6 Hours	
<b>Module10: PV Pumping</b>  Aim: To introduce with design and implementation of solar pumping system and status in Pakistan	LU-1:Agriculture LU-2:Scope of photovoltaic technology LU-3:Water pumping LU-4:Submersible pumps LU-5:Pump parameters LU-6:Design and installation of solar submersible pumps LU-7:Life cycle cost and future prospects of system	14 Hours	16 Hours

<b>Module11: Drip Irrigation</b>  Aim: Introduction of Drip irrigation, technicalities of the system, installation	LU-1:Drip Irrigation LU-2:Layout of the system and components detail LU-3:Pre-design tips LU-4:Design steps	12 Hours	18 Hours
		87	168

# Solar PV Training Curriculum Contents

**Module 1 Title:** *Introduction To basic Electrical System*

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

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1 Basic Electrical Terms and drawings</b>	Identify the symbols used in the electrical drawings	-Knowledge about different symbols -Interpret different symbols used in the layout -Differentiate different symbols	10 Hours	Electrician's tool kit Digital Multimeter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	Class Room and work place
	Knowledge about the basic Electrical Terms used in market	-Knowledge about basic electrical and electronic terms. -Understanding of electrical and electronic terms -Usage of electrical and electronic terms			
	Knowledge about Electrical/Electronic Drawings	-Identify Electrical/electronic drawings -Interpret Electrical/electronic drawings -Drawing the Electrical/electronic drawings			
<b>LU-2 Electrical Measuring Instruments</b>	Knowledge about the Types of Electrical Instruments used normally	-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
	Knowledge about how to use the Instruments	-Knowledge about which instrument to use -Knowledge about how to use instrument -Knowledge about where to use instrument			
	Knowledge about the Precautions need to use instruments	-Identify the right instrument for the task -Ensure the right connections of the Instruments -Repair and maintenance of the Instrument -Insulation, gloves protection			
<b>LU-3 Precautions and safety</b>	Precautions and safety before getting into work	-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
	Precautions and safety after completing work	-Wires are properly Insulated -There is not any faulty/ loose connection -Describe the regulations for -Hazardous areas installations			

<b>LU-4 Wiring Standards and layouts</b>	Ducting and piping	<ul style="list-style-type: none"> <li>-Explain the operation of change over system.</li> <li>-Draw Block diagram of the changeover system.</li> <li>-Interpret Schematic/circuit diagram of the changeover system.</li> <li>-Install Standby power supply</li> <li>-Differentiate between star delta connections.</li> <li>-Demonstrate skill in cable termination.</li> </ul>	3Hours	Electrician's tool kit  Digital Multi meter 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
	Wiring for standby systems	<ul style="list-style-type: none"> <li>-Determine the number and color of power cables and their route.</li> <li>-Draw block diagram of standby power Supply system.</li> <li>-Demonstrate installation</li> </ul>			
	Wiring main electrical circuit	<ul style="list-style-type: none"> <li>-Describe the purpose of earthing.</li> <li>-Installing system according to lay out plan.</li> </ul>			
	Wiring final circuit	<ul style="list-style-type: none"> <li>-State the types of conductors.</li> <li>-Enlist types of insulators</li> <li>-Determine the AWG wire size with a wire gauge.</li> <li>-Calculate the cross-sectional area of conductors.</li> <li>-Select wire size as per required load</li> <li>-Demonstrate skill in interpreting wiring diagrams.</li> <li>-Carry out wiring according to lay out plan</li> <li>-Demonstrate the skills used for the stripping,</li> <li>-Demonstrate the skills used for Tagging</li> <li>-Demonstrate the skills used for terminating conductors.</li> </ul>			

**Module 2 Title:** *Introduction to Basic PV system.*

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

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1 Understanding of the components involved in solar system</b>	Knowledge about Solar Panels	-Types of Solar Panels -Working of Solar Panels -Demonstration about solar panel	10Hours	Solar Panels Charge Controller Batteries Inverter	Class Room and work place
	Knowledge about Solar Charge Controller	-Types of Charge controllers -Working of Charge controllers -Demonstration about charge controller			
	Knowledge about Batteries	-Types of batteries -Working of batteries -Demonstration of batteries			
	Knowledge about Inverter	-Types of Inverters -Working of Inverters -Demonstration of inverter			
<b>LU-2 Learning Data sheets, Circuit diagrams, and other specifications of products</b>	Read data sheets and Specifications	-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

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

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

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1 Load analysis and Calculations for load.</b>	What are the types of load	-Types of Domestic load in shape of home appliances -Types of Industrial Load in shape of machines	6Hours	Electrician's tool kit Digital Multi meter 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
	How to calculate the load	-Understanding the specification mentioned on the products -Read the load using meters/Instruments -Load calculations in single phase -Load calculations in 3 phase			
<b>LU-2 Wiring Standards and layout for both AC and DC systems</b>	Wiring standards	-Types and sizes of wires available in market -Selection of wire according to the calculated load	3Hours	Electrician's tool kit Digital Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Driver Product Specification sheet DC wires, AC wires Connectors Jointer, Breakers	Class Room and work place
	Wiring For AC load	-Chose the wire for the AC Load system -Wiring of the AC load according to the layout diagram -Precautionary measurement while wiring -Jointer/Connectors for DC wires			
	Wiring For DC loads	-Choose the wire for the DC Load system -Wiring of the DC load according to the layout diagram -Precautionary measurement while wiring -Jointer/Connectors for DC wires			
<b>LU-3 Calculations for Components involved in Solar System</b>	Identify the power Rating and quantity of Solar Panels	-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 Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Product Specifications and data sheets	Class Room and work place
	Identify the rating of Charge Controller	-Calculation for Voltages of charge controllers -Calculations for Amperes of Charge Controller			
	Identify the rating for Inverter	-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	-Calculation For the Battery Backup Time -Calculation for Batteries Amperes -Calculation for Batteries Voltages			
<b>LU-4 Selection of components</b>	Identify the Feasible Solar Panel	-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	Class Room and work place



<b>involved in Solar System</b>	Identify the Feasible Charge Controller	-Type of the Charge controller best to utilize -Quantities or number according to the requirement or standards		Digital Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Product Specification sheet	
	Identify the Feasible Inverter	-Type of inverter best for the location -Quantities that can be installed for the safety of system			
	Identify the Feasible Batteries	-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.**

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

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1 Solar System being used in the world.</b>	Understanding of the types and way of Solar PV systems being used in the world	-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.
<b>LU-2 Orientation of Solar Panel</b>	Locate the right Direction to install Solar panel	-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
	Give the right tilt to the Solar Panel	-Amount of tilt needed according to the location -Use the irradiation meter to find the best possible outcome			
<b>LU-3 Erection and installation of Solar Panel</b>	Erection of Stand for solar panel	-Direction of stand according to the sun direction -Tilt of the stand according to the sun tilt -Select the material type of the stand -Iron, Aluminum, Steel -Select the type of stand -Tracking stand -Fixed Stand -Installation of Stand -Rowel-bolts -Foundation -Use of Greased Nut bolts	10Hours	Electrician's tool kit Radiance meter compass, ranch Drill Machine Iron Cutter plier nose plier straight Grease box	Work Place

	Fixing of solar panel on stand	-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	-Grease or oil the nut bolts -Open the nuts of solar panel without damaging it			
	Disassembling of Solar stand	-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			
<b>LU-4 Interconnections of components and circuit diagrams</b>	Connections of batteries	-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 Electrician’s tool kit Radiance meter compass, ranch	Class Room and work place
	Connections of Charge Controller	-Charge controller terminals drawing and specifications -Types of wire connectors for Charge Controller -Charge controller terminals and their connections stepwise -Setting parameters of Charge Controller (If Needed)			
	Connections of Solar Panel	-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		Drill Machine Iron Cutter plier nose plier straight Grease box Battery Thimbles Wire Connectors Solar Panel Connectors	
	Connections of Inverter	-Inverter terminals drawing and specifications -Types of wire connectors for Inverter -Inverter terminals and their connections stepwise -Setting parameters of Inverter (If Needed)			
<b>LU-5 Efficiency Measurement of solar system</b>	Check Efficiency of Solar Panel	-Find the radiance using radiance meter -Output /Input of the Solar Panel -Eliminate the shadowing effect	11Hours	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet	Class Room and work place
	Check Efficiency of Charge Controller	-Output /Input of the Charge Controller -Are Parameters set accordingly (If Needed)			

	Check Efficiency of Inverter	<ul style="list-style-type: none"> <li>-Output /Input of the Inverter</li> <li>-Are Parameters set accordingly (If Needed)</li> </ul>		Electrician's tool kit	
	Check Efficiency of Batteries	<ul style="list-style-type: none"> <li>-Backup Time according to the standard backup time.</li> <li>-Age of the batteries</li> <li>- Voltage level and charging level of batteries</li> </ul>		Radiance meter compass plier nose plier straight Battery Thimbles Wire Connectors Solar Panel	
<b>LU-6 Series and parallel combinations of systems</b>	Connections of Solar Panels	<ul style="list-style-type: none"> <li>-Calculations of Solar panels</li> <li>-Amperes and voltages needed.</li> <li>-Selection of solar panel</li> <li>-Arrays to achieve the targeted voltages and amperes</li> </ul>	13Hours	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet	Class Room and work place
	Connections of Charge Controller	<ul style="list-style-type: none"> <li>-Calculations of Charge Controller</li> <li>-Amperes and voltages needed.</li> <li>-Selection of charge controller</li> <li>-Sets of charge controller needed according to the feasibility and safety of system</li> </ul>		Electrician's tool kit  Radiance meter compass ranch Drill Machine Iron Cutter plier nose plier straight Battery Thimbles Wire Connectors Solar Panel Connectors	
	Connections of Inverter	<ul style="list-style-type: none"> <li>-Calculations of Inverter</li> <li>-Amperes and voltages needed.</li> <li>-Selection of Inverter</li> <li>-Sets of Inverter needed according to the feasibility and safety of system</li> </ul>		Digital Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	
	Connections of Batteries	<ul style="list-style-type: none"> <li>-Calculations of Batteries</li> <li>-Backup time needed</li> <li>-Amperes and voltages needed.</li> <li>-Selection of Batteries</li> <li>-Arrays to achieve the targeted need</li> </ul>			

## Module 5 Title: Load Management

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

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1 Load and deduction</b>	Reducing load	-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 Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	Class Room and work place
<b>LU-2 Different arrangements assemblies for solar in DC and AC circuits.</b>	Appliances for the DC system	-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 Plier nose Plier straight Digital Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester	Class Room and work place
	Appliances for the AC system	-Specifications of the AC appliances -Efficiency of the devices -Single phase and three phase appliances			
<b>LU-3 Wiring involved in Solar system for both AC</b>	Wiring for the DC system	-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
	Wiring for the AC system	-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		Plier, Nose plier Battery Thimbles Wire Connectors Solar Panel Connectors Voltage Tester Duct Pipe, Wires 6mm,3mm,2.5mm	

## Module 6 Title: Troubleshooting Solar System

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

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1 Inspection of a Solar system</b>	Check the installation visually for general compliance with the standards & regulations and referring to lay out plans.	-Demonstrate skills in interpreting layout drawings. -Explain characteristics of a proper installation. -Prepare inspection report on prescribed Performa.	5Hour	Electrician's tool kit  Digital Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	Class Room and work place
	Inspect the Solar System installations for defects and damages.	-Describe the Possible defects in Solar System installations. -Identify defective Parts.			
	Check Protective devices and accessories for damages	-Describe different types of protective devices and their use in protection circuits. -Identify deviations from the layout plan			
<b>LU-2 Testing of solar system</b>	Carry out the tests using specified electrical test instrument in conformity with regulations and standards and observing safety precautions	-Perform following tests: -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 Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses	Class Room and work place
	Test the installation for its working, locate faults and note down & prepare reports	-Describe the information deduct from above tests. -Prepare report on prescribed Performa.			
<b>LU-3 Repair and maintenance of the solar system</b>	Enlist the Necessary adjustments needed to check the Solar system.	-Describe common type of faults and their remedy	5Hour	Circuit Diagram Specifications and data sheet Electrician's tool kit Radiance Meter Compass Digital Multi meter Analog Voltmeter Analog Ampere meter	Class Room and work place
	Prepare list of items/material required for replacement and obtain them.	-Describe types of accessories and their application on installations.			

	Service/Repair/ replace defective Parts damaged wire/ cable, damaged / defective fixtures/fittings electrical accessories.	-Describe operation of different types of components that may be used in solar system -Demonstrate skills in repairing for assigned task		Analog Watt Meter Voltage Tester Breakers Fuses	
	Repair / or replace Electrical supply.	-Explain types of wires and accessories used in supply system			

### **Module 7 Title: System Types**

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

<b>Learning unit</b>	<b>Learning Outcomes</b>	<b>Learning Elements</b>	<b>Duration</b>	<b>Material Required</b>	<b>Learning Place</b>
<b>LU-1: Hand on experience for On-grid and Off-grid system including testing and connecting expertise</b>	Installation of Off-Grid system	-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
	Installation of On-Grid system	-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 Connector	
<b>LU-2 Stand alone and hybrid system, their advantages and disadvantages</b>	Installation of Standalone system Installation of Hybrid	-Types in standalone and hybrid inverters -Installation of standalone and hybrid inverters -Solar Panel Orientation and tilt -Connections of the solar panel, charge controller, batteries and inverters batteries and UPS	13Hour	Batteries Charge Controller Solar Panel Inverter Same as above	Class Room and work place
<b>LU-3 Installation, Testing and Troubleshooting of Solar Systems</b>	Troubleshooting in hybrid system	-Inspection of Solar System -Testing of Solar System -Repair of Solar System	12Hour	Batteries Charge Controller Solar Panel Inverter Specifications and data-sheet	Class Room and work place.
	Troubleshooting in Standalone System	-Inspection of Solar System -Testing of Solar System -Repair of Solar System		Electrician's tool kit	

	<p>Troubleshooting in off grid System</p>	<p>-Inspection of Solar System -Testing of Solar System -Repair of Solar System</p>		<p>Radiance meter compass ranch Drill Machine Iron Cutter plier nose plier straight Battery Thimbles Wire Connectors Solar Panel Connectors Digital Multi meter Analog Voltmeter Analog Ampere meter Analog Watt Meter Voltage Tester Breakers Fuses</p>	
--	---	---	--	--	--

**Module 8 Title: Other Renewable Energies****Duration: Total:** 6 Hours, **Theory** 4Hours, **Practical:** 2Hours

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1</b> Knowledge about the other sources of Renewable energies.	Solar Thermal	-Knowledge and understanding of -Solar Thermal	5Hours	Thermal Geyser Wind Turbine Specifications and data-sheet	Class Room and work place
	Wind Energy	-Knowledge and understanding of -Wind turbine			
	Geo thermal, Bio Gas, Tidal, Hydrogen Fuel cell, photosynthesis	-Knowledge and understanding of renewable energies that can be used to generate electricity			
<b>LU-2</b> Their percentage contribution in the world	Contribution of different types of renewable energies	Scope and current status	1Hour		Class Room is used for learning.

**Module 9 Title: Entrepreneur****Duration: Total:** 6 Hours, **Theory:** 6 Hours, **Practical:**

Learning unit	Learning Outcomes	Learning Elements	Duration	Material Required	Learning Place
<b>LU-1</b> Entrepreneurship	To deliver key difference between the thinking of an employee and an employer	-What is an Entrepreneurial Mindset? -The Entrepreneurial Process  -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	1Hours		Class Room.
<b>LU-2</b> Opportunity	To identify opportunity and act accordingly	-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 the business is about. -Sources and Types of Opportunity -Understanding the market and the customer need.	1Hours		Class Room.



<b>LU-3 Business Economics</b>	Charge clients according to the costs incurred and services provided	-Types of Costs; Break-even Analysis -fixed cost, variable cost, how to calculate break-even in a venture and explain how to extract money.	1Hours		Class Room.
<b>LU-4 Finance</b>	Generate finances for the business	-Sources of Finance -How to generate financing for the business venture. Sources include; Angel financing, from relatives, from banks, from NPO supporting the cause, Partnership. -Criteria Used by Different Sources of Finance -Requirements of financing institutes such as SMEDA, Banks etc. -Required Documentation.	1Hours		Class Room
<b>LU-5 Marketing Strategy</b>	How to attract clients to buy a services. How to create distinction in the market.	-How Marketing Evolves in Start-up Firms -Initial marketing practices. May include brochures, sign boards, standees, and newspaper. -Product Strategies suggesting feasible and relevant products to customers, -Setting Your Prices how to set prices of services and products provided. Low cost strategies, high quality strategy, and low cost / high quality strategy. -Crafting a Communications Approach -Convincing strategies, aimed at sales of product. -Setting Up Distribution -Making deals with existing companies to win their products for distribution in market.	2Hours		Class Room

***Module 10 Title: Solar Pumping System***

**Duration: Total:** 30 hours, **Theory:** 14 hours, **Practical:** 16 hours

Learning unit	Learning outcome	Learning Elements	Duration	Material required	Learning place
<b>LU-1 Agriculture</b>	-To provide with an overview of Pakistan's dependence on agriculture sector	-Percentage dependence of Pakistan's economy on agriculture	2 Hours		Class room
	-Technology limitations and constraints	-Technological limitations -Feasible options to increase the growth -Status and trends of solar pumping in Pakistan			
<b>LU-2: Scope of photovoltaic technology</b>	-To introduce with the PV technology	-Solar Potential in Pakistan -Brief introduction of solar technologies	2 Hours	Covered in previous modules of training (here only revision of PV installation will be done)	classroom
	-Solar system design and installation	-Brief introduction of solar system component -Design and installation of PV			
<b>LU-3: Water Pumping</b>	-Introduction and gain knowledge about conventional water irrigation systems	-surface irrigation -Localized irrigation/drip irrigation -sprinkler irrigation -center pivot irrigation -lateral move irrigation -sub irrigation -Manual irrigation	9 Hours	Pumps, animations, controllers	Classroom and workplace
	-different types of pumps	-Positive displacement/ piston pumps -centrifugal pumps -Submersible pumps - to learn about their different properties and applications			
	-Applications of different pump types	-Applications			
<b>LU-4: Submersible Pumps</b>	- To introduce with Submersible pumps working, installation and maintenance	-Submersible Pumps - Applications -Importance in agriculture -Comparison of submersible pumps with other pump types -Working principle of submersible pumps -Solar submersible pump system	5 Hours	Submersible pump	Classroom and workplace

<b>LU-5: Pump parameters</b>	-To learn pump parameters and characteristics	-Pump parameters -Bore hole characteristics and parameters -static head -dynamic head -required flow rate -Flow rate control and measurement methods -To learn and read pump characteristics and curves -rating of submersible pump	5 Hours	Pumps	Classroom and workplace
<b>LU-6: Design and Installation of PV submersible pump system</b>	-To learn design and installation of solar submersible pump system	-components of solar pumping system -design calculations of pump size and required solar system -performance analysis -Laser leveling -Technical issues and solutions	6 Hours	Submersible pump chain pulley bore accessories etc.	Classroom and workplace
<b>LU-7: Life cycle cost</b>	-To estimate cost of system and payback period	-life cycle cost (LCC) of submersible solar pump system -government initiatives for solar pumping system	1 Hours		Classroom

### **Module 11 Title: Drip Irrigation**

**Duration: Total:** 30 hours, **Theory:** 12 hours, **Practical:** 18 hours

<b>Learning unit</b>	<b>Learning outcome</b>	<b>Learning Elements</b>	<b>Duration</b>	<b>Material required</b>	<b>Learning place</b>
<b>LU-1:Drip Irrigation</b>	-To obtain knowledge about drip irrigation system and its prospects	-Why drip irrigation -Solution of spray irrigation problems -Maintenance, time, money and labor saving -Timer based -Pest and disease control -Subsurface drip irrigation -Advantages and disadvantages	3 Hours	Pumps regulators valves controllers water emitters	Classroom
<b>LU-2:Layout of the system and components detail</b>	-To get knowledge of system components	-Overview of components -Use of control valves -Manually operated and automatically operated Control valves -Why back flow preventer is needed -Use of filters in system -Water Flow pressure control by regulators -Adjustable regulators -Nonadjustable regulators -Water emitters -Pressure sensitive emitters -Pressure compensating emitters -Classification of emitters -Emitter spacing -Emitters placing	8 Hours	Layout, animation Pumps regulators valves controllers water emitters	Classroom, workplace

Learning unit	Learning outcome	Learning Elements	Duration	Material required	Learning place
		-Main pipeline -Drip Line			
<b>LU-3:Pre-design tips</b>	-Discussion of pre-design steps	-System Life -System uniformity -Water analysis -Soil analysis -Crop information -Pump test -Site information -Labor -Self chemical injection -Future expansion -Automation -Monitoring	7 Hours	System components Dripline Pumps, regulators, control valves, timers	Classroom, workplace
<b>LU-4:Design of system</b>	-Design discussion of drip water system -Detection of faults in system	-Design details -System accessories -Detection of system working -Cleaning of drip system -faulty function of venturi -Pressure dropping -Leakage of water -Problems in water flow	12 Hours	System components Dripline Pumps, regulators, control valves, timers	Classroom, workplace

# Solar PV Training Curriculum Assessment

**Module 1 Title:** *Introduction To basic Electrical System*

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

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

<b>LU-4</b> Wiring Standards and layouts	1Hours	2Hours	-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	
--	--------	--------	---	--	--

## Assessment context

- 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.

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:

- Commonly available instruments.
- Stationary and documentary material required.
- 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.

**Module 2 Title: Introduction to Basic PV system****Duration: Total:** 15 Hours, **Theory:** 5 Hours, **Practical:** 10 Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
<b>LU-1</b> Understanding of the components involved in solar system	3Hours	7Hours	-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	
<b>LU-2</b> Learning Data sheets, Circuit diagrams, and other specifications of products	2Hours	3Hours	-Interpret symbols used in a layout plan. -Differentiate between different views in a drawing. -Interpret given lay out plan.	Paper based Test Oral Demonstration	

**Assessment context**

- 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

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.

-Stationary and documentary material required.

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.

### ***Module 3 Title: Feasibility and Designing of Solar PV system***

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

<b>Learning units</b>	<b>Theory days/ hours</b>	<b>Workplace Days/ hours</b>	<b>Recommended formative assessment</b>	<b>Recommended methodology</b>	<b>Scheduled Dates</b>
<b>LU-1</b> Load analysis and Calculations for load.	4Hours	2Hours	-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	
<b>LU-2</b> Wiring Standards and layout for both AC and DC systems	2Hours	1Hours	-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	
<b>LU-3</b> Calculations for Components involved in Solar System	4Hours	2Hours	-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	
<b>LU-4</b> Selection of components involved in Solar System	5Hours	10Hours	-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	

### **Assessment context**

-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

#### **Assessment Condition:**

Assessment must confirm the candidate's ability to:

-Understand the Domestic/Industrial load requirements

-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.
- In depth knowledge about calculations for feasible solar system.

The candidate will have access to:

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

### ***Module 4 Title: Installation Of Solar PV system***

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

<b>Learning units</b>	<b>Theory days/ hours</b>	<b>Workplace Days/ hours</b>	<b>Recommended formative assessment</b>	<b>Recommended methodology</b>	<b>Scheduled Dates</b>
<b>LU-1</b> Solar System being used in the world.	1Hours		-Which are largest solar using countries -Which are the new emerging solar using countries -What are solar farms	Paper based Test Oral	
<b>LU-2</b> Orientation of Solar Panel		3Hours	-Orientation of panels must be in which direction -What is compass -Define shading -What is radiance meter and how it works -What is tilt angle and which instrument is used for setup?	Paper based Test Demonstration	
<b>LU-3</b> Erection and installation of Solar Panel		10Hours	-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 considered before disassembling solar panels	Demonstration	
<b>LU-4</b> Interconnections of components and circuit diagrams	1Hours	9Hours	-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 connect charge controller -What are the connectors use to inter connect the Solar Panels -What are the steps to connect the solar panel with charge controller -Types of connectors used to connect inverter -What are the main steps to connect the inverter to the battery	Demonstration	

<b>LU-5</b> Efficiency Measurement of solar system	1Hours	10Hours	-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	
<b>LU-6</b> Series and parallel combinations of systems	1Hours	12Hours	-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	

## Assessment context

-This unit could be assessed individually or in conjunction with other related units.

-Work may take place in a LAB or in open site

-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

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, tools, devices, stationary, documentary material.

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**

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

<b>Learning units</b>	<b>Theory days/ hours</b>	<b>Workplace Days/ hours</b>	<b>Recommended formative assessment</b>	<b>Recommended methodology</b>	<b>Scheduled Dates</b>
LU-1 Load Reduction and deduction	1Hours	3Hours	-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	-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	-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	

### **Assessment context**

- 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
  - 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

#### **Assessment condition**

- The candidate will have access to:
- Commonly available instruments.
- Tools like cutter, caliper, stripper, etc
- To Solar related devices
- Stationary and documentary material required.
- Relevant measuring Instruments.
- 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**

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

<b>Learning units</b>	<b>Theory days/ hours</b>	<b>Workplace Days/ hours</b>	<b>Recommended formative assessment</b>	<b>Recommended methodology</b>	<b>Scheduled Dates</b>
<b>LU-1</b> Inspection of a Solar system	1Hours	4Hours	-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 -Purpose of data sheet	Paper based Test Oral Demonstration	
<b>LU-2</b> Testing of solar system	1Hours	4Hours	-List down the reasons of batteries explosions -Explain what is blocking diode -Charge controller supports which type of voltages -What if selection of equipment 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. -Perform following tests: -Conductor continuity -Polarity Phase sequence Prospective over current/ short circuit current & voltage.	Paper based Test Oral Demonstration	

<b>LU-3</b> Repair and maintenance of the solar system	1Hours	4Hours	-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 Demonstration	
--	--------	--------	---	------------------------------	--

## Assessment context

- 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

### Assessment condition

- The candidate will have access to:
- Commonly available instruments.
  - tools like cutter, caliper, stripper, etc
  - 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

Resources required for assessment

- All tools and stationary and relevant information/ data

## Module 7 Title: System Types

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

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
<b>LU-1</b> Hand on experience for On-grid and Off- grid system including testing and connecting expertise	2Hours	9Hours	-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	

<b>LU-2</b> Stand alone and hybrid system, their advantages and disadvantages	2Hours	11Hours	-Differentiate between hybrid and standalone system -Design a standalone system for the given load -Write down the advantages and disadvantages of hybrid system -Write the advantages of Solar Tube-well reference to peter engine	Paper based Test Oral Demonstration	
<b>LU-3</b> Testing and Troubleshooting of Solar Systems	3Hours	9Hours	-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 standalone 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	

## Assessment context

- 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 following has been prepared:
  - On-Grid and Off-Grid systems
  - Standalone and hybrid systems
  - Testing standards of Solar System
  - Repair and maintenance related Solar System
  - 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:

- Commonly available instruments and tools, 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

Resources required for assessment

- All tools and stationary and relevant information/ data

**Module 8 Title: Other Renewable Energies****Duration: Total:** 6 Hour, **Theory:** 4 Hours, **Practical:** 2 Hours

Learning units	Theory days/ hours	Workplace Days/ hours	Recommended formative assessment	Recommended methodology	Scheduled Dates
<b>LU-1</b> Knowledge about the other sources of Renewable energies.	3Hours	2Hours	-Define Wind Energy -Explain Wind Turbine -What is Solar Thermal -What are the ways to use it -Explain Briefly Bio-Gas, Geothermal and Fuel Cell	Paper based Test	
<b>LU-2</b> Their percentage contribution in the world	1Hours		-Scope of fuel cell technology -which country is largest in solar electricity generation		

**Assessment context**

-This unit could be assessed individually or in conjunction with other related units.

-In this unit:

- Wind Energy
- Solar Thermal
- Other Renewable Energies

**Assessment condition**

The candidate will have access to:

- Commonly available instruments, tools etc
- Stationary and documentary material required.
- Data sheets, User manual and specifications

**Module 10 Title: Solar Pumping System****Duration: Total:** 30 hours, **Theory:** 14 hours, **Practical:** 16 hours

Learning unit	Theory days/ hours	Work place days/ hours	Recommended formative assessment	Recommended methodology	Scheduled dates
<b>LU-1 Agriculture</b>	2Hours		-What is current situation of agriculture sector -How much of total economy share is covered by agriculture in Pakistan -What type of pumps are currently in use -Describe the feasibility of deploying solar based pumping system to increase the growth -Which parts of Pakistan are abundant in solar potential	Paper based Oral	

<b>Learning unit</b>	<b>Theory days/ hours</b>	<b>Work place days/ hours</b>	<b>Recommended formative assessment</b>	<b>Recommended methodology</b>	<b>Scheduled dates</b>
<b>LU-2: Scope of photovoltaic technology</b>	2 Hours		<ul style="list-style-type: none"> <li>-Components of PV system</li> <li>-Design of PV components</li> <li>-selection among available PV technologies according to life cycle cost</li> <li>-How solar PV technology is important in water pumping systems</li> </ul>	Paper based	
<b>LU-3: Water Pumping</b>	3 Hours	6 Hours	<ul style="list-style-type: none"> <li>-What is difference between surface irrigation and drip irrigation</li> <li>-Why localized irrigation is effective</li> <li>-Sub irrigation is applicable in which type of areas</li> <li>-Describe the disadvantages in sprinkler irrigation</li> <li>-Why manufacturers provide relief valve in piston pump assembly</li> <li>-Name the types of common positive displacement pumps</li> <li>-Describe the rotary pump assembly</li> <li>-what is pumping capacity of positive displacement and rotary pumps</li> <li>-What would happen if discharge valve is closed in positive displacement pump</li> <li>-Describe the rotational mechanism of rotary pumps</li> <li>-Which type of drivers are used in centrifugal pumps</li> <li>-Can centrifugal pumps be used for viscous liquids</li> <li>-Give the comparison of centrifugal pumps and positive displacement pumps</li> <li>-Centrifugal pump assembly</li> <li>-What fault can cause vibration and noise in centrifugal pumps</li> <li>-Describe priming</li> <li>-Submersible pumps belong to which category of pumps</li> </ul>	Paper based	
<b>LU-4: Submersible Pumps</b>	2 Hours	3 Hours	<ul style="list-style-type: none"> <li>-Describe the structure of submersible pumps</li> <li>-Which condition can cause serious damage to pump</li> <li>-Why priming is not required in submersible pump</li> <li>-Describe the function of sheath (or covering)</li> </ul>	Paper based Oral	
<b>LU-5: Pump parameters</b>	2 Hours	3 Hours	<ul style="list-style-type: none"> <li>-Define water table</li> </ul>	Paper based	



Learning unit	Theory days/ hours	Work place days/ hours	Recommended formative assessment	Recommended methodology	Scheduled dates
			-Define head of system -Units of head used -Define dynamic head and static head -What is the effect of lower water table on head of pump -Define friction head -How outlet flow of the pump can be controlled -How flow rate of pump can be measured -Which type of pump installation is done if more head is required -Which type of head value is provided by manufacturers -How head pressure of the required system is calculated -Describe the pump performance and system curves		
<b>LU-6: Design and Installation of PV submersible pump system</b>	2 Hours	4 Hours	-Complete system design -fault detection and maintenance	Paper based	
<b>LU-7: Life cycle cost</b>	1Hours		-What is payback period of submersible pump system -What are the prospects of the submersible pump system in agriculture of Pakistan	Paper based	

### Assessment context:

- 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 equipment is installed.

In this unit, trainees will be able to:

- Design and install a complete solar PV pumping system
- Inspection of system
- Repair and maintenance of solar system
- Selection of pump parameters according to required application
- How to read pumps datasheet and curves
- Faults and maintenance of pumping system

### Assessment condition:

The candidate will have access to:

- Commonly available instruments and tools.
- Stationary and document material required.
- Data sheets, User manual and specifications

Resources required for assessment

- All tools and stationary and relevant information/ data

**Module 11 Title: Drip Irrigation****Duration: Total: 30 Hours, Theory: 12 Hours, Practical: 18 Hours**

<b>Learning unit</b>	<b>Theory days/ hours</b>	<b>Work place days/ hours</b>	<b>Recommended formative assessment</b>	<b>Recommended methodology</b>	<b>Scheduled dates</b>
<b>LU-1:Drip Irrigation</b>	3 Hours		-Describe the effectiveness of the system -How drip irrigation gives a solution to problem of weeds -What are the type of crops that can be irrigated via this system	Paper based	
<b>LU-2:Layout of the system and components detail</b>	3 Hours	5 Hours	-What should be the minimum distance between emitters -How many control valves can be used in system -Describe isolation valve usage -Why supply water gets contaminated and how to avoid this -What is the placement of different types of regulators in installation -Can a single regulator be used for multiple control valves -Describe the reasons to use filters -Where should we install filters in system -How flow rate of emitters is indicated by manufacturers -Describe drip line -Define laser tubing	Paper based	
<b>LU-3:Pre-design tips</b>	2 Hours	5 Hours	-Why soil analysis is important before system design -To select proper filtration device what type of analysis is required -Why pre design water cost, quantity and fertilizer should be known	Paper based	
<b>LU-4:Design of system</b>	4 Hours	8 Hours	-Assessor can ask to design system components for any given design requirements -How installed system is tested	Paper based	

## **Assessment context**

-This unit could be assessed individually or in conjunction with other related units

In this unit, trainees will be able to:

- Understand and design drip irrigation system
- Inspection of system

### **Assessment condition:**

The candidate will have access to:

- Necessary tools and instruments
- Stationary and document material required.
- Relevant measuring instruments.
- Data sheets, user manual and specifications

Resources required for assessment

- All tools and stationary and relevant information/ data