

# Solar Panel and Photovoltaic

## Syllabus: First Semester

<b>1. Basics Electrical and Electronics</b>		
<b>Sr. N.</b>	<b>Theory</b>	<b>Practical</b>
1	<p>a. Introduction to Conventional &amp; Non-conventional sources of energy</p> <p>b. Difference between conventional &amp; Nonconventional energy &amp; their limitations</p> <p>c. Advantages &amp; Disadvantages of Non-conventional energy</p> <p>d. Solar Energy:</p> <p>Reasons for Non-conventional energy being not so popular.</p> <p>Chances for development of Non-conventional energy in India</p>	Demonstration of Conventional & Non-conventional energy sources
2	<p>Basics of Electricity:</p> <p>Atomic Structure – Proton, Neutron &amp; Electron</p> <p>Characteristics &amp; Laws of Electricity Various methods of generation of Electricity Definitions of Voltage, current, Resistance &amp; their units.</p> <p>Ohm's Law</p> <p>Symbols used in Electrical system</p> <p>Electrical Safety – Hazards &amp; Safety measures.</p> <p>First Aid</p>	<p>Demonstration of various Safety Measures.</p> <p>Demonstration of First Aid.</p> <p>Study &amp; application of various electrical symbols. Demonstration of Ohm's Law</p>
3	<p>Introduction to Electric circuit. AC &amp; DC current. Series</p>	Study & practice various electrical circuits. Measurement of voltage,

	<p>&amp; parallel connections. AC Single phase &amp; three phase.</p> <p>Frequency.</p> <p>Electric Power &amp; Energy. Joules Law.</p> <p>Conductors, Resistors &amp; Insulators.</p> <p>Resistance of Wires made of different materials.</p> <p>Types of Wiring. Faults in wiring &amp; their effects.</p> <p>Earthing: Importance &amp; Types</p>	<p>current, power, Energy &amp; frequency</p> <p>Demonstration of Conductors, Resistors &amp; Insulators.</p> <p>Demonstration of Earthing systems.</p>
4	<p>Introduction to Photo-voltaic Cell. Advantages &amp; disadvantages of photo-voltaic conversion.</p> <p>Use of solar cell in various instruments.</p> <p>Photo-voltaic array &amp; its connections, arrangements of array according to the voltage.</p> <p>Module &amp; its connections.</p> <p>Faults &amp; their effects in photo-voltaic cell, array &amp; module (connection of cell, connection of array, connection of module)</p>	<p>Prepare wiring using various accessories in solar electricity &amp; perform its testing.</p> <p>Make a series &amp; parallel wiring in solar electricity &amp; prepare a table of equations of voltage &amp; current.</p> <p>To study the faults &amp; their remedies in the wiring in solar electricity.</p> <p>Make an array using photo-voltaic cell in solar electricity.</p> <p>Prepare modules of various capacities with the help of array.</p> <p>In solar electricity, make a 2000 capacity power pack, connect with instruments &amp; test it.</p>
5	<p>Introduction to Lead-acid battery: construction, parts &amp; working. Anode, cathode &amp; Electrolyte (sulphuric acid + distilled water).</p> <p>Construction &amp; working of Hydrometer.</p> <p>Working of a battery capacity tester.</p> <p>Connection of battery (series &amp; parallel). Battery cable &amp; lamp. Maintenance &amp; faults in a battery (battery box, negative &amp; positive plates, cell</p>	<p>In the charging system of solar electricity, perform servicing of lead acid battery (deep discharge battery), measure specific gravity &amp; voltage.</p> <p>Note the capacity of the battery.</p>

	connector, terminal, electrolyte, specific gravity, battery voltage)	
<b>2. Solar lighting system</b>		
	<b>Theory</b>	<b>Practical</b>
	<ul style="list-style-type: none"> <li>• Description of main parts of solar lighting system: Solar Lantern, street light, home light</li> <li>• Charge controller</li> <li>• Storage battery</li> <li>• Inverter</li> <li>• Luminars</li> <li>• Maintenance of solar lighting system</li> <li>• Major solar lighting manufacturers in India.</li> <li>• Comparative study of Conventional lighting system &amp; solar lighting system</li> </ul>	<p>Study solar photovoltaic module.</p> <p>Charge the battery &amp; trace out fault.</p> <p>Assemble a solar lighting system</p> <p>Carryout first hand maintenance</p> <p>Dismantle every part of solar lantern, study the construction &amp; function of solar parts</p> <p>Test for fault finding</p> <p>Dismantle every part of solar home light system, study the Construction&amp; function of each part.</p> <p>List for finding of the faults.</p>
7	Solar Photovoltaic system: Check the functions of different parts up to the performance level expected.	Identifying all components of a simple DC solar lighting system & solar lantern Segregating defective parts & labeling them
8	Role of an Installer Description of trade	Planning installation activity
9	Need for personal safety & safety of others. Dangers associated with working at heights. Methods of safety practices while using different hand tools.	Adopt all safety practices: -Safe use of ladders, safe working in open terraces & other risky &elevated places. - Correct handling of heavy

	<p>Impact of incorrect lifting of objects, system components (especially battery) while installing at heights &amp; while working.</p> <p>Personal protective equipment&amp; their usage.</p> <p>Knowledge of the causes of accident &amp; its remedial actions.</p>	<p>components</p> <ul style="list-style-type: none"> <li>- Use of personal protective equipment (PPE) like gloves, goggles, safety belts etc</li> <li>- Handling any incidents / accidents</li> </ul>
10	<p>Battery: Typical values of battery voltage, module current &amp; voltage.</p> <p>Acid &amp; their properties, current flow in batteries &amp; impact of shorting of terminals.</p> <p>Charging process &amp; precautions to be taken while charging a battery</p>	<p>Safe handling of batteries &amp; maintenance. Checking batteries for their function.</p> <p>Correcting the gravity of acid &amp; charging the battery.</p>
11	Different types of tools & their use	Use of installation tools
12	<p>Sun movement over the day, shadowing effects.</p> <p>Risks involved in Hydrogen released by batteries &amp; the need for ventilation. Charge controller basic functions.</p>	<p>Identifying current location of the solar modules, correct installation practice, correct location for charge controller &amp; batteries &amp; visual indications in charge controller &amp; check for proper functioning.</p>
13	Short circuit length, aesthetics, maximizing the utility (as in the case of lighting max space) & convenience.	Wiring plan & location of loads & charge controllers & modules to avoid loss
14	Commissioning steps	Commissioning the Solar Electric system
15	Overall operation of system, safe use & basic maintenance & trouble shooting	Educating the customer on use
16	I&C format & contents	Documentation
17	Registering complaints, tracing & disposing complaints, customer relations.	Complaint management system

### 3. Solar Electric system Installation & Servicing

	Theory	Practical
1	Knowledge about dimensions & quality of steel sheets used for making hot tank outer & inner	Checking dimensions & thickness of the sheets with the standard for the size of the tank to be produced.
2	Knowledge of parts & functions of a shearing machine. Importance & practices of marking dimensions on sheet as per the tank size. Safe disposal of scraps without damaging self or the surroundings.	Practice on sheet cutting by shearing machine. Marking dimensions on sheet as per the tank size. Selecting correct template for cutting as per the size of the water tank. Checking shear edge before operating the machine. Collecting scraps & putting them in proper place for disposal.
3	Knowledge of parts & the functions of a power press & hand press	Checking the number of punches to be made & the pitch. Checking the number of tubes to be inserted. Checking the dimensions of punch hole required. Checking the stopper setting before starting operation. Punching the required number of holes & at the spacing as needed. Collecting the scraps & putting in the drum for disposal
4	Knowledge of parts & functions of a bending machine.	Checking settings of the bending machine before handling. Safe handling of bending machine. Bending sheets at the edges & forming the cylindrical tube shape.
5	Knowledge of parts & functions of a Linear welding machine. Knowledge of parts & functions of gas welding machine.	Adjusting current, voltage in the welding machine, setting temperature (current level) according to the thickness of sheets. Checking the settings of the machine before welding the sheets. Checking the quality of welding after cooling.
6	Knowledge of parts & functions of a Nipple welding machine.	Practice Tube welding.

7	<p>Knowledge of capacity of gas cylinders.</p> <p>Method of knowing the availability of gas in the cylinders.</p>	Replacing the Gas cylinders
8	<p>Safety precautions while handling inflammable gas cylinders, replacing the pipes &amp; regulators. Environmental impacts of gas leakage.</p>	Checking gas pipes for leakage before starting
9	<p>Safety precautions to be taken while operating a shearing machine, power press, bending machine, linear welding &amp; nipple welding machines.</p>	Practice on use of Eye protecting glass, gloves, shoes Inserting the shirts & folding the sleeves in case of full arm shirts.
10	<p>Importance of team work &amp; mutual cooperation.</p>	Practice on working in a team for bringing material, setting the machine, loading & unloading, removing the scraps, cutting, punching, bending, grooving, collar making & welding.
11	<p>Solar cooker:</p> <ul style="list-style-type: none"> <li>-Basic working principle</li> <li>- Designs available in the market</li> <li>-Information on solar cookers manufacturers in India</li> <li>-Introduction to solar cookers for household &amp; community applications</li> <li>- Operation &amp; maintenance.</li> <li>- Servingschedule.</li> <li>- Disadvantages &amp; Limitations.</li> </ul>	<p>Solar cooker:</p> <ul style="list-style-type: none"> <li>-Study solar cookers designs / components</li> <li>- Assemble solar cookers</li> <li>- General maintenance schedule for solar cooker components</li> <li>- Fault finding &amp; troubleshooting.</li> </ul>
12	<p>Solar Water Heaters (SWH):</p> <ul style="list-style-type: none"> <li>- Basic working principle of solar hot water system – copper flat plate &amp; Evacuated tube collectors (ETC)</li> <li>- Parts of a SWH &amp; criticality.</li> <li>- Types of system – Thermo Siphon / systems operating under pressure / no pressure / heat exchangers.</li> <li>-Importance of insulation &amp; insulation materials.</li> <li>- Equipment handling, moving to location &amp; erection (sequentially).</li> <li>- Basic Electrical knowledge.</li> <li>- Basic plumbing knowledge / pipe sizes.</li> </ul>	<p>Solar Water Heaters (SWH):</p> <ul style="list-style-type: none"> <li>-Able to distinguish between copper based flat plate collector &amp; Evacuated tube collectors (ETC)</li> <li>- Flow diagrams – reading &amp; understanding various systems / drawings / animated representation.</li> <li>- System installation (erection) ensuring leakproof joints.</li> <li>- Safe transportation, erection &amp; commissioning.</li> <li>- Connecting electrical back-up heaters.</li> </ul>
13	<ul style="list-style-type: none"> <li>-Role of an Installer.</li> <li>- Description of trade.</li> </ul>	Planning installation activity of Solar hot water system

14	<ul style="list-style-type: none"> <li>-Need for personal safety &amp; safety of others. Dangers associated with working at heights, methods of safety practices while using different hand tools.</li> <li>- Impact of incorrect lifting of objects, system components (tank, ETC tubes) &amp; while installing at heights.</li> <li>-Importance of using Personal Protective Equipments (PPE) &amp; their usage.</li> <li>- Installation in the presence of end users.</li> <li>- Handling hotparts.</li> <li>- Knowledge of the cause &amp; remedial actions.</li> </ul>	<ul style="list-style-type: none"> <li>- Adopt all safetypractices.</li> <li>- Safe use of ladders, safe working in open terraces &amp; other risky &amp; elevatedplaces.</li> <li>- Correct handling of heavycomponents.</li> <li>- Use of personal protective equipments (PPE)like gloves, goggles, safety beltsetc.</li> <li>- Handling any incidents /accidents.</li> <li>- Precautions againstheat.</li> </ul>
15	Collector components, cover glass / ETC tubes	Safe handling of collectors
16	Different types of tools & its operation	Use of installation tools
17	Use of Thermometer & standard measuring devices.	Measurement of temperature, volume & dimensions.
18	<ul style="list-style-type: none"> <li>-Sun movement over the day, shadowing effects</li> <li>- Carrying out site survey to identify suitability &amp;location</li> <li>- Water quality – hard /soft,remedies.</li> <li>- Availability of other support system (overhead water tank / plumbing arrangement / electricalaccess).</li> <li>- Recommending correct size &amp;type of system.</li> </ul>	Identifying correct location of the solar collectors / system capacity / water quality