WIND & SOLAR ENERGY APPLIANCES (2037694(037))

List of Experiments

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6	Prepare delicious food by using solar cooker.
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Experiment No: 1

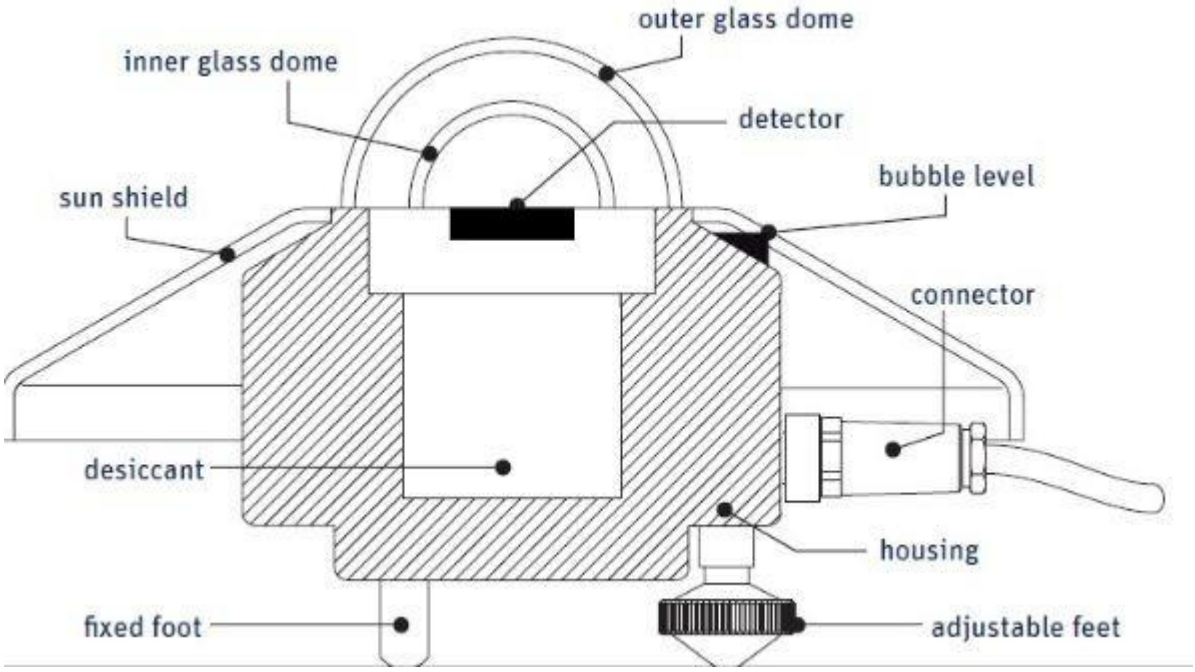
Aim: Study of Solar Radiation by using Pyranometer.

Theory: A **pyranometer** is a type of actinometer used for measuring solar irradiance on a planar surface and it is designed to measure the solar radiation flux density (W/m^2) from the hemisphere above within a wavelength range 0.3 μm to 3 μm. The name pyranometer stems from the Greek words (pyr), meaning "fire", and (ano), meaning "above, sky".

A typical pyranometer does not require any power to operate. However, recent technical development includes use of electronics in pyranometers, which do require (low) external power.

Procedure: A pyranometer is an instrument which measures either global or diffuse radiation.

A black surface on the guard plate is covered by a transparent glass domes. The hot junctions of the thermopile are connected to black furnace and the cold junctions of thermopile are connected where there is no solar radiation. The other ends of thermopile are connected to millivoltmeter. The entire equipment rests on the mounting plate. The mounting plate is fixed on the plat form with the help of bolts. Leveling screws are provided.



When the sunrays falling on the black surface, heat is generated inside the glass dome. This causes the temperature difference takes place in the two junctions of the thermopile. As a result, an e.m.f is generated and it is recorded in the millivoltmeter.

EXPERIMENT NO: 2

Aim: Study of Solar Distillation or Solar Still.

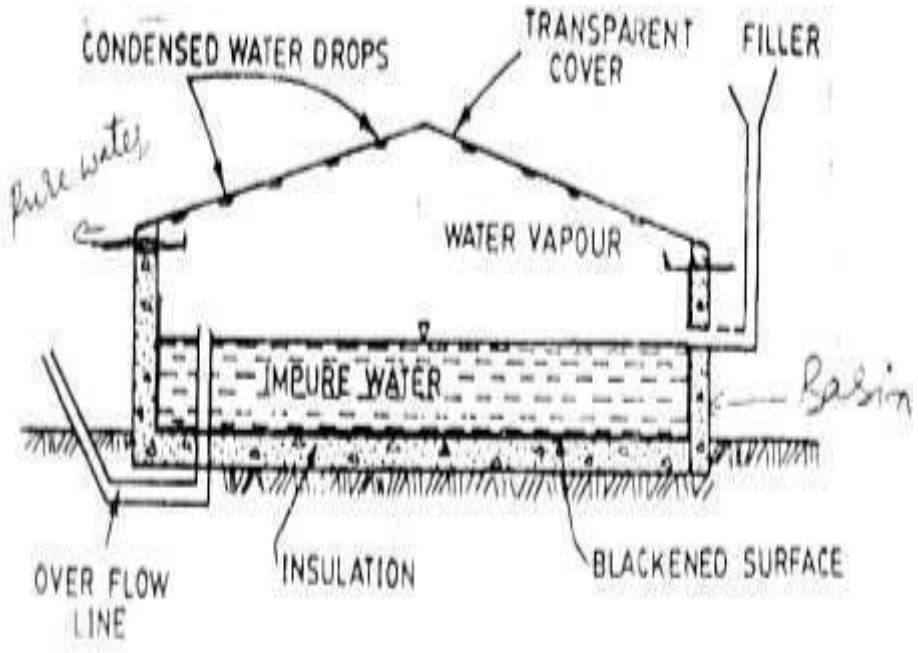
Apparatus: 1. Transparent Covers

2. Filler
3. Over flow line
4. Insulation
5. Blackened surface
6. Basin

Objective:

Fresh water is a necessity for the sustenance of life and also the key to man's prosperity. It is observed that, arid and coastal areas which are thinly populated, the family members are always busy in bringing fresh water from a long distance. In these areas solar energy is plentiful and can be used for converting saline water in to distilled water by using solar still.

Procedure: It consists of a insulated blackened basin containing saline water. A transparent cover is enclosed on the top of the basin. It has a roof like shape. The cover, which is usually glass or plastic sheet. . Solar radiation passes through the cover and is absorbed and converted into heat in the black surface. Impure water in the basin is heated and the vapour produced is condensed as water drops on the interior of the roof. The condensed water can be collected through the pipes provided in the solar still.



Solar Water Still

Questions for evaluation:

Q1. What are the main parts of Solar Distillation or Solar Still?

Ans. 1. Transparent covers; 2. Filler 3. Over flow line; 4. Insulation;
5. Blackened surface; 6. Basin.

Q2. What is the use of Transparent?

Ans. Transparent cover acts as an solar
collector.

Q3. What acts as an absorber?

Ans. A black body acts as an absorber.

Q4. What is the use of Solar Distillation?

Ans. The impure water can be purified with the help of Solar Distillation.

EXPERIMENTNO: 3

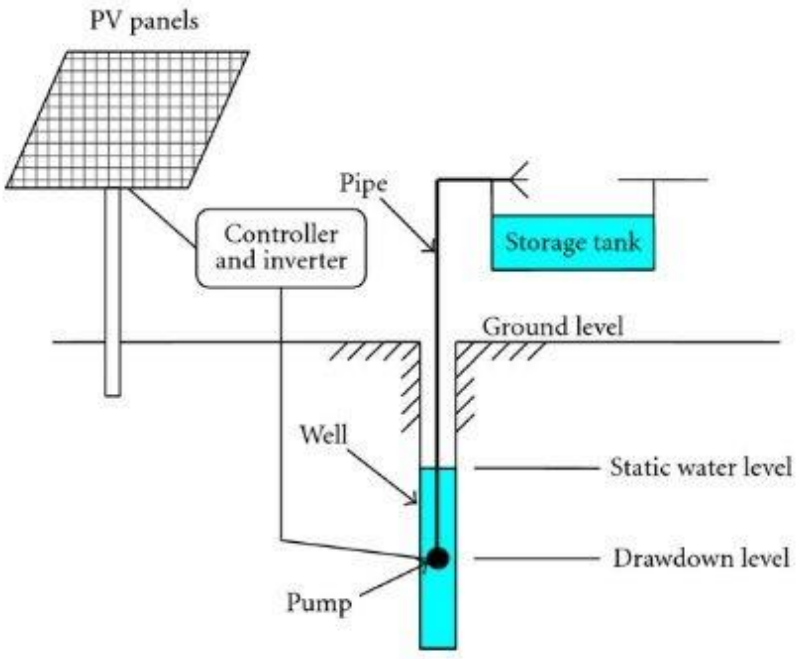
Aim: Study of solar water pumping.

Apparatus: 1. Solar collector array

2. Heat exchanger
3. Organic fluid
4. Heat engine
5. Condenser
6. Pump

Description:

1. **Solar collector array:** It consists of solar collector and water tubes. The inner surface of the collector and the water tubes are coated with black paint.
2. **Heat Exchanger:** It consists of two pipes, one is for carrying hot water and other is for circulating organic fluid.
3. **Organic fluid:** The organic fluid changes its phase from liquid to vapour when it is hot and vapour to liquid when it gets cool.
4. **Heat engine :** It consists of a turbine
5. **Condenser:** It consists of two pipes one is for carrying organic fluid and other is for pumping the ground water.
6. **Pump:** Pump shaft is coupled with heat engine shaft. It is used to pump the water.



Working:

When the sun rays falls on the solar collector, black body absorbs the sun rays and water in the tubes gets heated up and circulates in the heat exchanger. Through the heat exchanger, hot water is again pumped back in the solar collector with the help of a pump.

The organic fluid in the other tube sences the heat produced in the heat exchanger and converts its phase in to vapour. The vapour runs the turbine provided in the heat engine and losses its heat, and again converted in to liquid. This organic fluid again pumped back in to the heat exchanger with the help of a feed pump.

Ground water is pumped with the help of a pump, which is coupled with heat engine.

Questions for Evaluation:

After performing the practical task the students are required to answer the following questions:

Q1. What are the main parts of Solar Water Pumping?

Ans.1. Solar collector array; 2. Heat exchanger; 3. Organic fluid; 4. Heat engine; 5.Condenser; 6. Pump

Q2. Describe solar collector array?

Ans. It consists of solar collector and water tubes. The inner surface of the collector and the water tubes are coated with black paint.

Q3. Describe Heat Exchanger?

Ans. It consists of two pipes, one is for carrying hot water and other is for circulating organic fluid.

Q4. Describe organic fluid?

Ans. The organic fluid changes its phase from liquid to vapour when it is hot and vapour to liquid when it gets cool.

Q5. Describe Heat engine?

Ans. It consists of a turbine and it is coupled with a pump.

Q6. Describe condenser?

Ans. It consists of two pipes one is for carrying organic fluid and other is for pumping the ground water.

Q7. Describe Pump?

Ans. Pump is used to pump the water and it is coupled with heat engine.

EXPERIMENT NO: 4

Aim: To study the constructional details of a box type solar cooker.

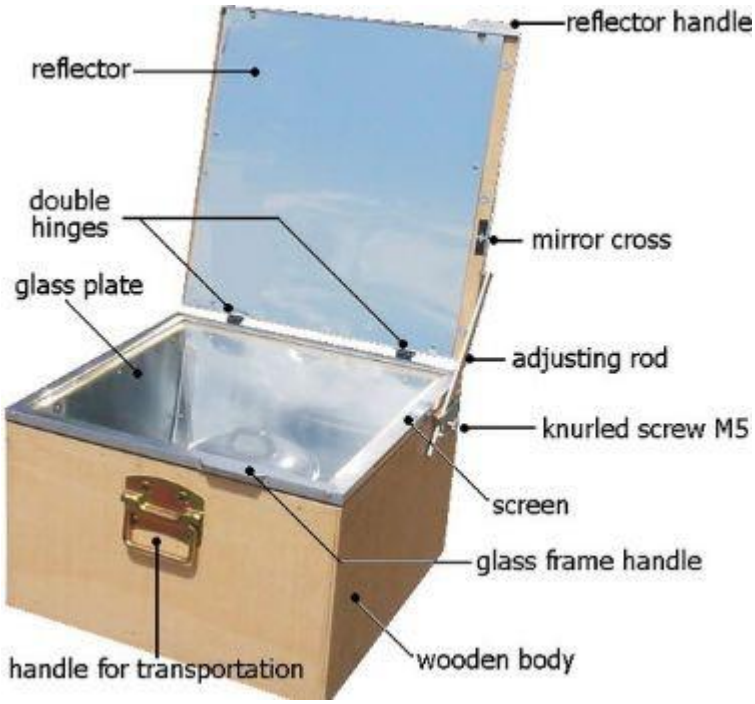
Apparatus: 1. Insulated box

2. Two transparent glass plates (collectors)
3. Reflecting mirror
4. Guide for adjustment of reflecting mirror
5. Handle
6. Cooking pots
7. Black board paint (Absorber)

Procedure:

Two transparent glass plates of 3mm thick are fixed on the top of the insulated box, keeping about 25mm distance between the two glass covers. Neoprene rubber sealing is provided around the glass covers and the cooker box. A black paint is coated on the surface of the vessels and inside the box. This black body acts as an absorber.

The solar radiation entering the box is of short wave length. The two glass covers minimizes the heat loss and transmission of long wave radiation. When the sun rays falls on collectors or glass plates, enters in to the cooker box. The black body absorbs the solar radiation and generates heat inside the box. The cooking pots gets heat energy and food will be cooked. Solar energy can be tracked by using reflector or mirror. A mechanism or clamp is provided to adjust the reflector at different angles on the cooker box. Insulating materials like glass wool or saw dust is filled in the space between blackened tray and outer cover of the box. This minimizes heat losses.



Questions for Evaluation:

Q1. What are the main parts of Solar Cooker?

Ans.1. Insulated box 2. Two transparent glass plates (Collectors); 3. Reflecting mirror; 4.Guide for adjustment of reflecting mirror 5. Handles 6. Cooking pots 7. Black board paint (Absorber);

Q2. What is Solar Collector?

Ans. Solar Collector is a device which collects solar radiation. Usually transparent glass plates are used as solar collectors.

Q3. What is an absorber?

Ans. A black body acts as an absorber. It absorbs the solar radiation.

Q4. What is the use of reflector?

Ans. It is used for tracking the solar energy. Usually a mirror is used as a reflector. A mechanism or clamp is provided to adjust the reflector at different angles on the cooker box.

Q5. What is the use of insulating material?

Ans. The material which does not conduct heat is called insulating material. Insulating materials like glass wool or saw dust is filled in the space between blackened tray and outer cover of the box. This minimizes heat losses.

Q6. What is the thickness of transparent glass plates?

Ans. The thickness of transparent glass plate is 3mm.

Q7. What is the distance between the two glass covers?

Ans. The distance between the two glass covers is 25mm.

Experiment No: 5

Aim: Prepare delicious food by using solar cooker.

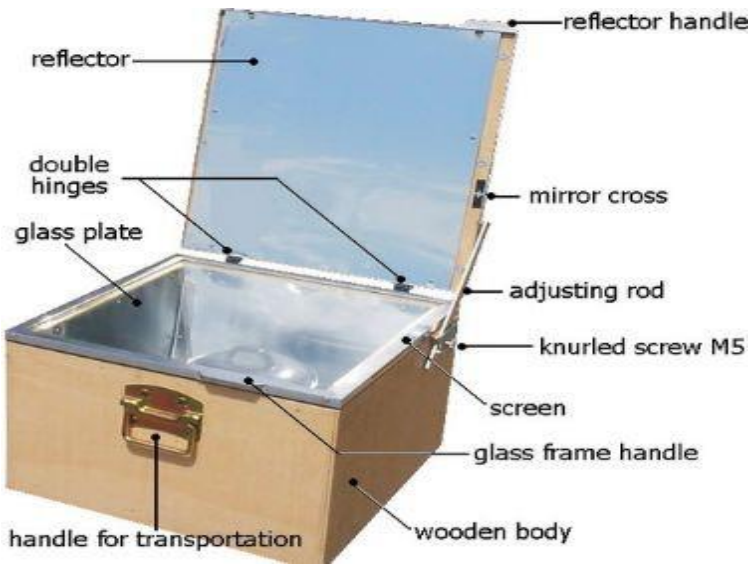
Apparatus: Solar cooker, cooking pots

Ingredients: Rice, water, salt

Procedure:

1. Place the cooker in the sun. The place selected should receive direct sun shine. Ensure that it will not come under the shadows of trees or buildings.
2. Leave the reflector mirror in the open position at an angle which permits the sun's rays on the collector or glass covers.
3. Wipe dust, foreign particles and moisture from both mirror and glass surfaces.
4. Allow a minimum pre – heating time of about 30 minutes if the food is to be sent in the cooker at 10-00A.M., place the cooker in sun at 9-30A.M or earlier.
5. While the cooker gets pre – heated, lift the glass cover of the cooking tray and remove the cooking pots.
6. Load the material to be cooked along with the required quantity of water and close the cooking pots.
7. Keep the cooking pots on the tray and close the double glass cover of the tray.
8. None the food is left to be cooked.

The food will be ready in one or two hours, depending upon the intensity of sun.



Solar Cooker

Observation Table

Sl. No.	Experiment Conducting Time	Type of food	Duration hrs.	Remarks

Questions for Evaluation:

Q1. What are the main apparatus required for preparing food?

Ans. Solar Cooker and Cooking Pots.

EXPERIMENT NO: 6

Aim: Study of Water Heater.

Apparatus: 1. Flat plate collector

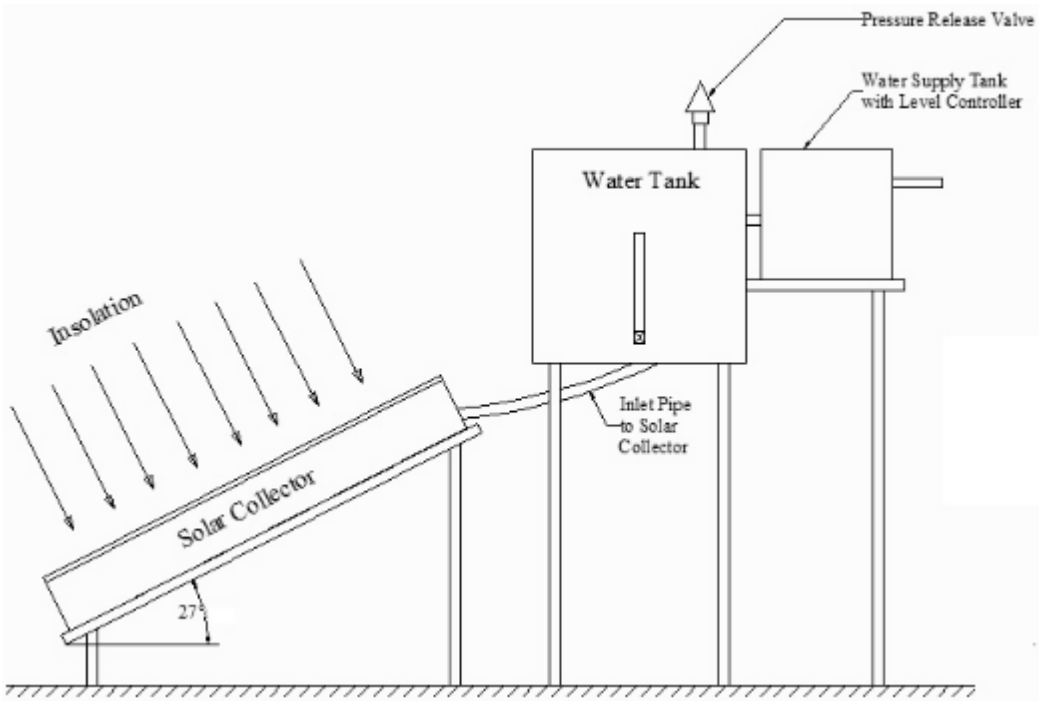
2. Insulated storage tank
3. Connecting pipes.

Procedure:

A flat plate collector is used to collect solar radiation and converts it into thermal energy. Insulated storage tank is used to hold the hot water for use and cold water for feeding the flat plate collector.

Connecting pipes inlet and outlet is used for feeding cold water from the storage tank and taking hot water from the storage tank.

As water in the collector is heated by solar energy, it flows automatically to the top of the water tank and its place is taken by colder water from the bottom of the tank. Hot water for use is withdrawn from the top of the tank. An auxiliary heating system is provided for use on cloudy or rainy days.



Solar Water Heater

Questions for Evaluation:

Q1. What are the apparatus required for solar water heating system?
Ans. 1. Flat plate collector 2. Insulated storage tank 3. Connecting pipes

Q2. What is the use of flat plate collector?

Ans.A flat plate collector is used to collect solar radiation and converts it in to thermal energy.

Q3. What are the different types of solar water heating systems?

Ans. 1. Thermosiphon or Natural Circulation System and 2. Forced circulation system.

Q4. What is the use of an auxiliary heating system?

Ans.An auxiliary heating system is provided for use on cloudy or rainy days.

Q5. What is the use of insulating material?

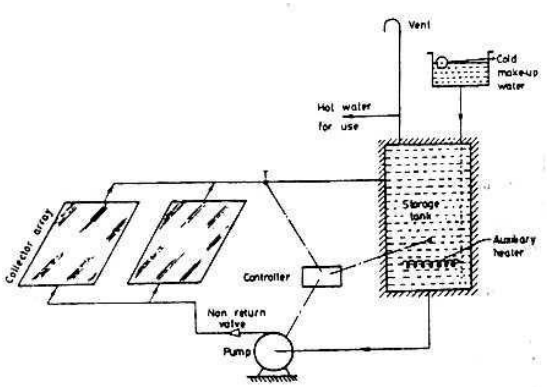
Ans. It minimizes heat losses.

EXPERIMENT NO: 7

Aim: Study of Forced circulation solar water heating system.

Apparatus:

1. Arrays of flat plate collector
2. Insulated storage tank
3. Pump
4. Connecting pipes
5. Auxiliary heating system



Procedure:

Water is fed by some mechanical device like pump is known as forced circulation system. This type of water heater is used for industrial purposes where large quantity of water required to heat. The main components are:

- **Arrays of Flat plate collector:**

  It is used to absorb solar radiation and convert it in to thermal energy.

- **Insulated storage tank:**
  It is used to hold the hot water for use and cold water for feeding the arrays of collector.
- **Pump:** It is used to feed cold water into arrays of flat plate collector
- **Connecting pipes:** Inlet and out let pipes are used for feeding cold water from the Storage tank and taking hot water from the storage tank.
- **Auxiliary heating system: It** is provided for use on cloudy or rainy days and during nights. Systems of this type are well suited for places like hospitals, hotels, milk dairy, industries etc.

Observation Table

Sl. No.	Experiment Conducting Time	Quantity of Water	Initial Temperature	Final Temperature	Duration hrs.	Remarks

Questions for Evaluation:

Q1. What are the main apparatus used in forced circulation solar water heating system ?

Ans. 1. Arrays of flat plate collector; 2. Insulated storage tank; 3. Pump; 4. Connecting pipes;

5. Auxiliary heating system;

EXPERIMENT NO: 8

Aim: Study of Solar Street Lighting and Lanterns.

Apparatus: 1. Photovoltaic module or solar array

2. Lighting device
3. Inverter
4. Battery

Objectives of solar lighting:

In our country out of six lack villages, one lack village is still to be electrified. Even in electrified villages, only a quarter of house – holds have proper connection.

The bulk of rural house – holds in India, normally use kerosene lanterns for meeting their lighting requirements. These lanterns provided insufficient and poor quality of light.

A variety of solar photo – voltaic system have been developed and employed for rural applications such as lighting.

(a) Solar Lantern:

This consists of a small photovoltaic module or solar array, a lighting device, inverter, battery etc. During day time, module or array is placed under the sun and is connected to lantern through cable for charging. A typical lantern uses a 100 watt lamp.Storage battery is one crucial component in lantern. The battery has a life of 3 to 5 years.

Solar Lantern

(b) Street lighting system:

It consists of two photo – voltaic modules, mounting frame, 4mt long pole, battery box, lead – acid battery and inverter. It works with one fluorescent tube light of 20 watts for whole night.

Solar Street Lighting

Questions for Evaluation:

Q1. What are the main apparatus used for solar street lighting and lanterns?

Ans. 1. Photovoltaic module or solar array; 2. Lighting device; 3. Inverter; 4. Battery;

Q2. What is solar photovoltaic?

Ans. The direct conversion of solar energy in to electrical energy by means of the photo voltaic effect, that is, the conversion of light in to electricity.

Q3. Define photo voltaic effect?

Ans. The photo voltaic effect is defined as the generation of an electromotive force as a result of the absorption of ionizing radiation.

Q4. What is solar cell?

Ans. Energy conversion devices which are used to convert sun light of electricity by the use of the photovoltaic effect are called solar cells. Solar cells are made of semi – conductors like silicon.

Experiment No: 9

Aim: Study of Horizontal Wind Mill.

Apparatus:

1. Induction generator and gear box
2. Blade (Single or Double or Multiblade)
3. Rotor
4. Transmission
5. Tower

Description: In this, the axis of rotation of wind mill is horizontal. Horizontal axis wind mills are further classified as single bladed, double bladed and multibladed.

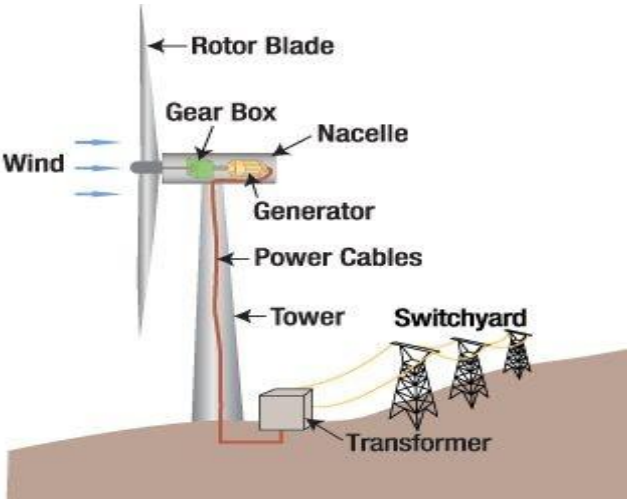
Main components of the wind mill are:

(i). Rotor: It consists of blades. Rotor is mounted on the horizontal shaft and connected to the generator through transmission with the help of bearings.

(ii). Transmission: It consists of gears, belts, chains, clutches etc., It controls the wind speed or rotor speed according to the generator speed. When the wind speed is low, the transmission system increases rotor sped. Similarly when the wind speed high, it decreases the rotor speed.

(iii). Generator: It generates Electricity

(iv). Tower: Tower is a supporting device. It holds all the parts of wind mill. It is made of reinforced concrete or Iron poles. The height of the tower depends on the capacity of the plant.



Wind Mill

Question for Evaluation:

Q1. What are the main parts of Horizontal wind mill?

Ans. 1. Introduction generator and gear box; 2. Hub; 3. Counter Weight; 4. Composite blade; 5. Tower.

Q2. How do you classify wind mills?

Ans. Wind mills are classified as (a) Horizontal wind mills and (b) Vertical wind mills

Q3. What are caused because of two factors:

(i) The absorption of solar energy on the earth's surface and in the atmosphere.

(ii) The rotation of the earth about its axis and its motion around the sun

Q4. How wind mill works?

Ans. A wind mill converts the Kinetic Energy of moving air into mechanical Energy that can be either used directly to run the machine or to run the generator to produce electricity.