



# SNS COLLEGE OF TECHNOLOGY



(An Autonomous Institution)

## SOLAR ENERGY

### Solar Energy Conversions

Sun is an inexhaustible and pollution free source of energy. Solar radiation from the sun mainly contains visible light and when it falls on the earth most of them can be converted into thermal radiations. Thermal energy of the radiation is important. Now we have several techniques for conversion of direct sunlight into more useful forms. This solar energy conversion occurs by the following two mechanisms.

1. Thermal Conversion
2. Photo Conversion

#### 1. Thermal Conversion:

Thermal conversion involves absorption of thermal energy in the form of IR radiation. Solar energy is an important source for low-temperature heat (temperature below  $100^{\circ}\text{C}$ ), which is useful in Solar Cookers and Solar Water Heaters.

##### (a) *Solar Heat Collectors:*

Solar heat collectors consist of natural materials like stones, bricks (or) materials like glass, which can absorb heat during the day time and release it slowly at night.

**Uses:** It is generally used in cold places, where houses are kept in hot condition using solar heat collectors.

**b) Solar cookers:** Solar radiation is allowed to fall on a plane mirror and directed into a metallic box whose inner surface is blackened. The heat obtained is used for cooking. Some times large lenses are used to converge radiation to a point for heating. A new designed solar cookers use concave mirrors instead of plane mirror for enhanced efficiency.

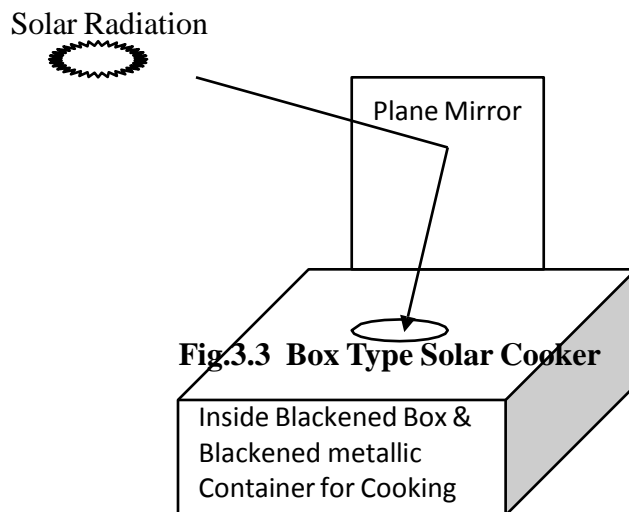
Food cooked in solar cooker is more nutritious due to slow heating but the limitation is that it cannot be used during night and rainy season.



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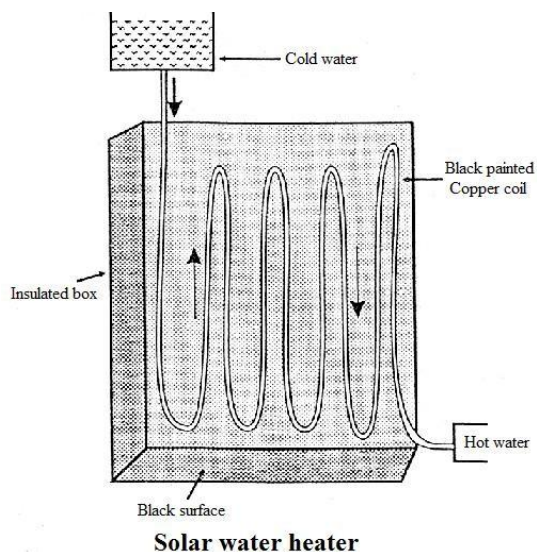


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## (b) Solar Water Heater:

It consists of an insulated box inside of which is painted with black paint. It is also provided with a glass lid to receive and store solar heat. Inside the box it has black painted copper coil, through which cold water is allowed to flow in, which gets heated up and flows out into a storage tank. From the storage tank water is supplied, to the end users, through pipes.



## 2. Photo conversion



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Photo conversion involves conversion of light energy directly into electrical energy.

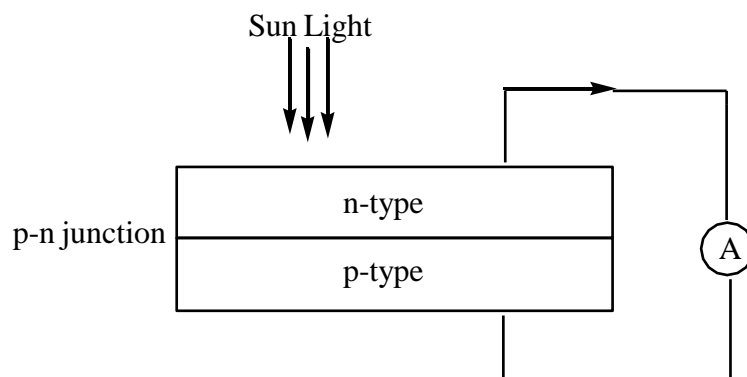
## a) Photovoltaic cell (or) solar cell

**Definition:** Photovoltaic cell is the one, which converts the solar energy (energy obtained from the sun) directly into electrical energy

### Principle:

The basic principle involved in the solar cells is based on the photovoltaic effect. When the solar rays fall on a two layer of semiconductor devices, a potential difference is produced between the two layers. This potential difference causes flow of electrons and produces electricity.

Solar cells consist of p-type semiconductor (such as Si doped with B) and n – type semiconductor (such as Si doped with P). They are in close contact with each other. When the solar rays fall on the top layer of n –type semiconductor, the electrons from the valence band get promoted to the conduction band and cross the p-n junction into p – type semiconductor. There by potential difference between two layers is created, which causes flow of electrons (i.e., electric current). The potential difference and hence current increases as more solar rays fall on the surface of the top layers. Thus when this p and n layers are connected to an external circuit, electrons flow from n –layer to p-layer, and hence current is generated.





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A typical PV cell produces about 0.5-0.6 V DC under open circuit. Output depends on the : (i) efficiency of the semiconductor material used (ii) size (surface area) (iii) intensity of light.

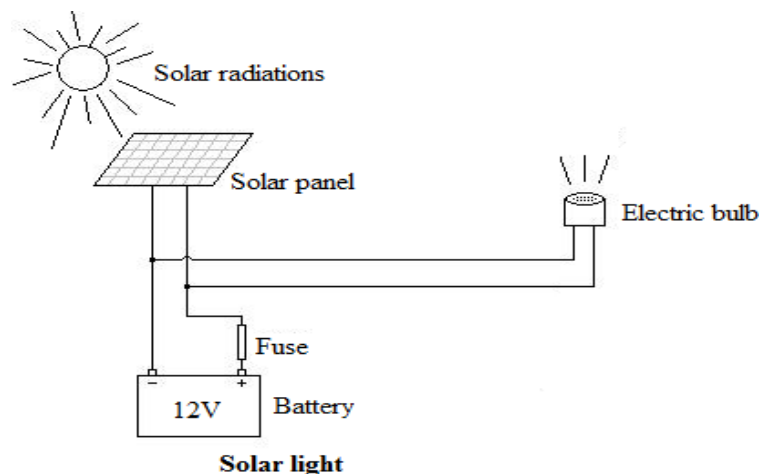
## Applications of solar cells

### 1. Lighting Purpose (remote area power system)

Array solar cells can harness large amount of solar energy and can produce electricity enough to light street lights. The current can also be stored in rechargeable batteries and current is drawn whenever required. This has got the advantage that the energy is available even when sun is not shining.

### 2. Solar Pumps run by Solar battery

When a large number of solar cells are connected in series, it forms a solar battery.



1. Solar battery produces more electricity which is enough to run, water pump, street-light, etc.,
2. They are also used in remote areas where conventional electricity supply is a problem.
3. Solar cells are used in calculators, electronic watches, radios and TVs.



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4. Solar cells are superior to other type of cells, because these are nonpolluting and eco – friendly.
5. Solar energy can be stored in Ni-Cd batteries and lead-acid batteries.
6. Solar cells can be used to drive vehicles.
7. Solar cells are used as a source of electricity in space craft and satellites.

## **Advantages:**

- ✓ Solar energy is free
- ✓ Available in abundance
- ✓ Pollution free, as it has no carbon dioxide emissions
- ✓ Recurring fuel cost is zero
- ✓ Land requirement is less.

## ***Disadvantages***

- Capital cost is high.
- Energy storage is not possible.