Solar Energy Awareness (Syllabus) :

(i) Understand how and how much energy from the sun reaches us at various places and times, and what happens to it. Understand motion of the sun, make the use of instruments to observe / locate Sun's position – Angular measurement from the horizon and from the true north. Use of household Indian Almanac (Panchang). Make and use a Sundial.

(ii) Know different ways of collecting storing and using Solar energy for getting heat and electricity. Flat Plate and concentrating collectors-use of glass covers, reflectors and lances including fresnel lances. Make working models of at least two devices-Solar Cookers, Dryers, still (to make distilled water), Oven, Water Heater, Photovoltaic-say battery charger, Lanterns, Pump, T.V. power supply etc. for personal/family use.

(iii) (a) See and be able to explain working of at least three Solar energy installations of different types.

(b) Know how to use Solar Cooker/Water Heater, what can be done and how, with it.

(iv) Know advantages. disadvantages of using Solar Energy. Government and other Organisations who assist/test/manufacture.

Solar Energy and It's transmission

It takes solar energy an average of 8 ⅓ minutes to reach Earth from the Sun. This energy travels about 149 million km through space to reach the top of Earth's atmosphere. Waves of solar energy radiate, or spread out, from the Sun and travel at the speed of light through the vacuum of space as electromagnetic radiation. The majority of the Sun's radiation reaching Earth is in the form of visible light we can see and invisible infrared energy that we can't see. A smaller portion of sunlight is made up of ultraviolet radiation, which is also invisible to our eyes.

Other forms of radiation from the Sun can reach Earth as part of the solar wind, but in smaller quantities and with longer travel times. The solar wind contains plasma and particles and can also include gamma rays and x-rays resulting from solar storms or other bursts of energy from the Sun's surface.

Solar energy and relative distance from sun

The Sun's energy we receive is electromagnetic radiation that travels through space or a medium in the form of waves or particles. The visible light we see from the Sun is similar to the visible light from a light bulb, but the Sun provides much more of it. The

energy released from the sun is mind-bogglingly large, equal to about 36 octillion (3.6 x 1028) or 36 thousand trillion trillion lumens, where a lumen is a measure of the total amount of visible light. This brightness (or intensity) falls off with distance from the source by a factor of 1/d2, where d2 is the square of the distance. From the surface of Mercury, depending on the planet's position in its orbit, the Sun would appear from seven to eleven times brighter as it does when viewed from Earth. By the time the Sun's energy reaches Earth's surface, it has a globally averaged brightness of about 127,000 lumens per square meter. The intensity of sunlight reaching a particular spot on Earth at any time depends on location and time of year, as lower sun angles spread the incoming energy over a larger surface area.

Solar energy and life on earth

Energy from the Sun makes it possible for life to exist on Earth. It is responsible for photosynthesis in plants, vision in animals, and many other natural processes, such as the movements of air and water that create weather. Most plants need at least some sunlight to grow, so without light, there would be no plants, and without plants, there would not be oxygen for us to breathe. Infrared radiation from the Sun is responsible for heating the Earth's atmosphere and surface. Without energy from the Sun, Earth would freeze. There would be no winds, ocean currents, or clouds to transport water.

Solar energy and man

Throughout history, humans have used technology to harness the Sun's energy as a source of light and heat and for growing crops. As early as 30 CE, people were constructing greenhouses to grow plants out of season. Early civilizations knew that setting up shelters to capture or block sunlight could help with heating and cooling. In cold climates, they would position buildings to face southward, allowing interior spaces to gather heat and light. In warm climates, shelters might be constructed under cliffs or natural overhangs to protect the residents from the Sun's radiation in the hottest part of the day. Using energy from the Sun effectively also helped with growing crops.

Sundials

Sundials are the oldest known instruments for telling time. The surface of a sundial has markings for each hour of daylight. As the Sun moves across the sky, another part of the sundial casts a shadow on these markings. The position of the shadow shows what time it is.

The flat surface of a sundial is called a dial plate. It may be made of metal, wood, stone, or other materials. Numbered lines on the dial plate, called hour lines, show the hours of the day. A part called a gnomon sticks up at an angle from the dial plate. The sloping

edge of the gnomon is called the style. As the day passes, the gnomon's shadow moves around the dial. Every hour it falls on a new hour line.

Collection and storage of sunlight

There are several ways to collect and store sunlight, including:

- Photovoltaics (PV): Solar panels that use sunlight to create electrical charges. PV is the most common method of harvesting solar energy.
- Concentrating solar-thermal power (CSP): Large power plants that use mirrors to focus sunlight onto receivers that convert it to heat.
- Flat-plate collectors: These devices convert solar energy into thermal energy.
- Solar ponds: Salt water bodies that collect and store solar energy.
- Solar ovens: These ovens concentrate sunlight from a large area to a central point to cook food.
- Thermal energy harvesting: Uses black bodies to absorb and transfer electromagnetic radiation, which can be used in water heating systems.
- Trombe walls: A masonry wall on the south side of a house with a layer of glass in front that absorbs solar heat and stores it in the wall. The heat then radiates into the living space.
- Flywheel storage: A heavy wheel attached to a rotating shaft that can be made to turn faster by expending energy. When the wheel is attached to an electrical generator, it can produce electricity

  Solar Cooker

  Solar cooking is identified as one of the most viable and sustainable cooking alternatives which offers key advantages including food nutrition retention, low cost, and environment-friendly operations.

  The solar cooker could be useful to residential schools, institutional kitchens such as industrial and administrative canteens, religious ashrams, hotels, hospitals, police, and armed forces kitchens, etc. Solar cookers can save around 35 to 40 LPG cylinders/ year on full use in community kitchens.

  Solar cookers have been designed to cater to specific cooking methods (boiling, frying, roasting, baking) and can be broadly classified into four types.
- Solar Box Cookers (~100 °C)
- Concentrating Solar Cookers (>100 °C) (e.g., Parabolic dish)
- Advanced Round-the-Clock (RTC) with heat storage/Indoor Solar Cookers (>100 °C)
- Community Solar Cookers (superheated steam-based) Community-based solar cookers are popular in temples around India (e.g., the Shirdi Sai Temple in Maharashtra).

Solar Water Heater

Solar water heater is a device that helps in heating water by using the energy from the SUN. Solar energy is used for heating water. Water is easily heated to a temperature of 60-80o C. Solar water heater of Solar water heaters (SWHs) of 100-300 liters capacity are suited for domestic use. Larger systems can be used in restaurants, canteens, guest houses, hotels, hospitals etc. A 100 liters capacity SWH can replace an electric geyser for residential use and may save approximately 1500 units of electricity annually. The use of 1000 SWHs of 100 liters capacity each can contribute to a peak load saving of approximately 1 MW. A SWH of 100 liters capacity can prevent emission of 1.5 tones of carbon dioxide per year.

Working of a Solar Water Heater

The Sun's rays fall on the collector panel (a component of solar water heating system). A black absorbing surface (absorber) inside the collectors absorbs solar radiation and transfers the heat energy to water flowing through it. Heated water is collected in a tank which is insulated to prevent heat loss. Circulation of water from the tank through the collectors and back to the tank continues automatically due to thermo siphon system. Based on the collector system, solar water heaters can be of two types: A solar water heater consists of a collector to collect solar energy and an insulated storage tank to store hot water. The stored hot water can be used later any time.

Advantages of solar energy

Solar energy has many advantages,

- Renewable
  Solar energy is a renewable energy source that comes from the sun and can't be used up.
- Clean
  Solar energy doesn't produce greenhouse gas emissions or other pollutants, and it can reduce water consumption.
- Low maintenance
  Solar panels don't have moving parts and require little maintenance.
- Cost-effective
  Solar energy can reduce energy bills and provide long-term savings. It can also be cheaper to install and maintain over time.
- Versatile
  Solar energy can be used for many purposes, including cooking, water heating, and generating electricity.

- Reliable
  Solar energy is available in large amounts and can be used in remote areas that aren’t connected to energy grids.
- Energy independence
  Solar energy can help improve energy security and independence. Some ways to take advantage of this include net metering, which credits homeowners for electricity they return to the grid, and government tax credits