SNS COLLEGE OF ENGINEERING
Kurumbapalayam (Po), Coimbatore – 641 107
AN AUTONOMOUS INSTITUTION
Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EE711 SOLAR AND WIND ENERGY

UNIT III-SOLAR RESOURCE

Introduction to solar energy:

Solar energy is the radiant light and heat from the sun that has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation along with secondary solar resources account for most of the available renewable energy on earth. All other renewable energies other than geothermal derive their energy from energy received from the sun.
Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute sunlight. Active solar techniques include the use of Photovoltaic Modules (Solar cells) (Solar to Electrical) and Solar Thermal Collectors (Solar to Thermal) with suitable equipment to convert sunlight into useful outputs. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

We will study only Active Solar techniques with Solar Cells in this course.

Important features of Solar Energy:

- **SUN** the source of '***Solar energy'*** is a huge, glowing sphere of hot gas with ***1.4 million kilometer*** diameter. Most of this gas is hydrogen (about 70%) and helium (about 28%).
- Due to Nuclear fusion reaction of Hydrogen with Helium internal temperaturesreach over ***20 million Kelvin***.
- The resulting loss of mass due to fusion is converted into about **3.8 × 10^{20} MW** of electromagnetic energy (power) that radiates outward from the surface intospace.
- The spectrum of solar radiation is close to that of a blackbody @ **5800 K**.
- The amount of energy reaching the surface of the Earth every hour is

greater than the amount of energy used by the Earth's population over an entire year.

Terms used in Solar Energy: Irradiance, Irradiation & Insolation :

Irradiance: is the rate at which radiant energy is incident on a surface per unit area (**W/m^2**) and is represented by the symbol **G.**

Irradiation: is the incident energy per unit area (**J/m^2**) on a surface - determined by integration of irradiance over a specified time, usually an hour or a day.

Insolation: is a term used to indicate '***Solar Energy Irradiation'***. (An abbreviation for '***In****cident* ***Sol****ar Radi****ation'***)

- *While solar irradiance is most commonly measured, a more common form of radiation data, solar Insolation is the total amount of solar energy received at a particular location during a specified time period, often in units of kWh/(m^2 -day).*

- *While the units of solar Insolation and solar irradiance are both a power density (for solar Insolation the "hours" in the numerator are a time measurement as is the "day" in the denominator), solar Insolation is quite different than the solar irradiance as the solar Insolation is the instantaneous solar irradiance averaged over a given time period.*

- *Solar Insolation data is commonly used for simple PV system design while solar radiance is used in more complicated PV system performance evaluation which calculates the system performance at each point in the day.*

1. Extra Terrestrial &Terrestrial Solar Radiation:

While the solar radiation incident on the Earth's atmosphere which is known as ***Extraterrestrial Solar Radiation*** is relatively constant, the radiation at the Earth's surface which is known as ***Terrestrial Solar Radiation*** varies widely due to:

- Atmospheric effects, including absorption and scattering.
- Local variations in the atmosphere, such as water vapour, clouds, andpollution.
- Latitude of the location and
- Season of the year and the time of day.

The above effects have several impacts on the solar radiation received at the Earth's surface. These changes include:

- Variations in the overall power received, the spectral content of the energy and the angle from which light is incident on a surface.
- In addition, a key change is that the variability of the solar radiation at a particular location increases dramatically. The variability is due to both local effects such as clouds and seasonal variations, as well as other effects such as the length of the day at particular latitude.
- Desert regions tend to have lower variations due to local atmospheric phenomena such as clouds. Equatorial regions have low variability betweenseasons.
- As solar radiation makes its way toward the earth’s surface, some of it is absorbed by various constituents in the atmosphere, giving the terrestrial spectrum an irregular, bumpy shape.
- The terrestrial spectrum also depends on how much atmosphere the radiation has to pass through to reach the surface. This is explained by a term called *Air Mass Ratio.*