# Measurement of solar radiation at particular location

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## ABSTRACT

In this paper, we have concentrated on the estimation of solar radiation at the location with Latitude 23.70° and Longitude 72.50°. We have estimated the parameters related to the solar radiation like declination angle ($\delta$), Sunshine hour angle ($\omega_s$), and solar Irradiance ($I_L$). The solar irradiance is measured by days, by months, throughout the year eventually monthly average global solar irradiance is estimated.

**Key-words:** solar irradiance, declination angle, sun shine hour angle.

## INTRODUCTION

Solar radiation is the direct form of abundant permanent solar energy resource available at every place with different amount on earth, due to nuclear fusion in Sun. Earth surface receives about one hundred thousand TW of this radiation energy of solar power at each moment. Clouds, gases, pollution (including aerosol) and other factor reduces this available power on surface and thus, Earth gets about 800 times less solar radiation energy from the sun at each moment (Schiermeier et.al., 2008). Despite of the fact is that only 71 minutes of solar energy is good enough to satisfy the demand of solar energy of earth's population for one year. As a matter of fact about one thousand watts per square meters of solar energy reaches at landmass of the earth [1].

Solar energy occupies one of the most significant places among the different possible alternative energy sources. An accurate knowledge of solar radiation distribution at a particular geographical location is of vital importance for the development of many solar energy devices and for estimates of their performances. Unfortunately, for many developing countries solar radiation measurements are not easily available for not being able to afford the measurement equipment and techniques involved. Therefore, it is rather important to elaborate methods to estimate the solar radiation on the basis of more readily meteorological data [2].

The solar irradiance at ground level changes in intensity and spectrum due to changing atmospheric parameters such as the cloud cover, the turbidity, the water vapor content and the zenith angle [3-6]. The effect of the variations of the solar spectrum on the performance of the different photovoltaic devices is not yet quantified on a large scale because of the difficulty to

obtain spectral measurements. Therefore, it is rather important to elaborate methods to estimate the influence of the varying atmospheric conditions on the solar cells performance [7].

## METHODOLOGY OF ESTIMATION

Solar Irradiance is measured using solar power meter.

Declination angle can be calculated using

$$\delta = 23.45\, sin[360\left(\frac{284+n}{365}\right)] \quad \text{.....(1)}$$

where, n is numbers of day in year

Sunshine hour angle can be calculated using

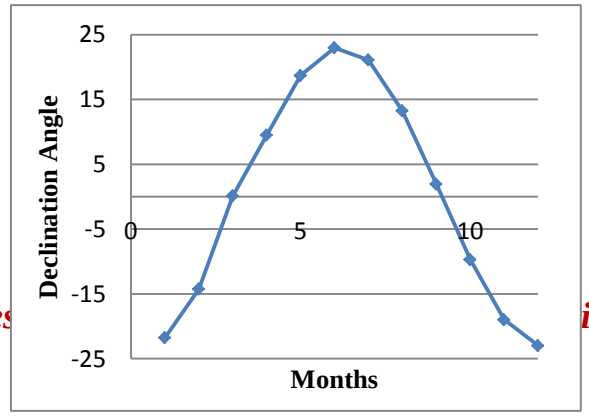
$$\omega_s = \cos^{-1}(-\tan\emptyset\,.\tan\delta) \quad \text{.....(2)}$$

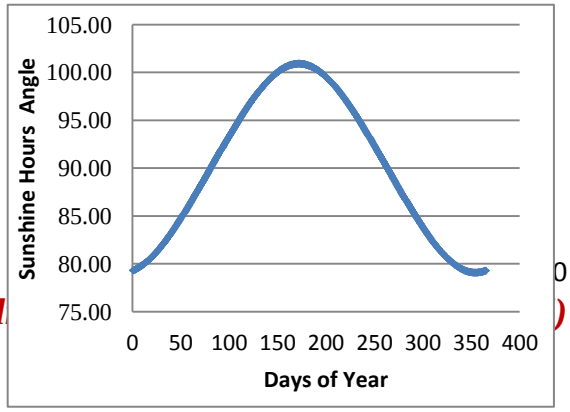
Where, $\emptyset$ = lattitude of location and $\delta$ =declination angle.

## RSULTS AND DISCUSSION

Table.01 (Estimation of Solar Radiation Parameters)

| Months | Monthly Average Solar Irradiance ($I_L$) (kwh/m$^2$.month) | Declination Angle ($\delta$) | Sunshine Hour Angle ($\omega_s$) |
|---|---|---|---|
| January | 140 | -21.75 | 79.45 |
| February | 153 | -14.26 | 84.05 |
| March | 198 | 0.11 | 86.95 |
| April | 202 | 9.48 | 93.20 |
| May | 210 | 18.69 | 95.57 |
| June | 175 | 22.97 | 101.72 |
| July | 132 | 21.08 | 98.71 |
| August | 128 | 13.23 | 94.94 |
| September | 157 | 1.97 | 91.87 |
| October | 165 | -9.7 | 84.63 |
| November | 138 | -18.96 | 82.31 |
| December | 132 | -22.98 | 75.27 |



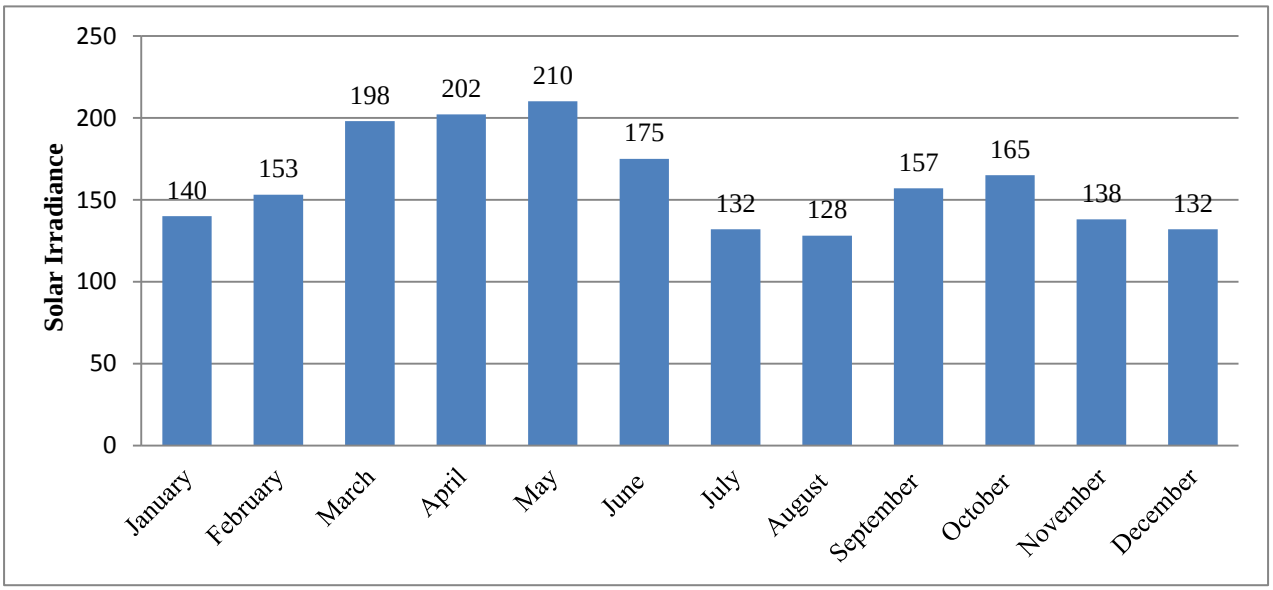



**Figure 3. Estimation of solar irradiance.**

**FigFigure 2. Sunshine Hour Angle**

In the above table 1. we have mentioned solar irradiance data which has been measured throughout the year by day to day and month to month. The declination angle is calculated using Eq.1 and Sunshine hour angle is calculated using Eq.2. From the above Figure.01 we can clearly estimate that the declination angle is maximum in the month of June and it is very low for January and December months. From Figure.2 we can empirically estimate the sunshine hour angle for the month of June is very high and it is very less for the months of January and December. From Figure.03 we can confirm that the solar irradiance is very high during the month of may ($I_L$=210 kwh/$m^2$.month) and for the month of August, the solar irradiance is noted very less compare to the other months.

## CONCLUSION

By performing numbers of observations and calculations, we have eventually concluded that the solar irradiance is continuously changing throughout the year. We have recorded maximum value of monthly average global solar irradiance is 210 kwh/$m^2$.month in the month of May and less amount of irradiance is recorded about 128 kwh/$m^2$.month in the month of August for the location with Latitude 23.70° and Longitude 72.53°. It is perfectly concluded that the declination angle and Sunshine hour changes in same pattern with months of years.

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