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Experimental Study of Different Effects on PV Module and Improvement in Power of PV Module at Location New Delhi

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Abstract: ***In this paper the experimental study provides effects of cloud, temperature change, dust over the panel and tilt angle of Phot ovoltaic panel has been discussed and studies. This study is not for the hot summer but it is for upcoming winter i.e. from 1st of October 2014 to 30th of November 2014. Also the study over tilt has been made as maximum power is when the tilt angle is between 45° to 55° as it allows maximum beam radiation to fall on the photovoltaic that provides the maximum power as output. While experimental study over temperature change on the photovoltaic the power is being effected as is shown in the graph plots of P-V and I-V curve for tempera ture change throughout the day. Study over temperatures at 28 ℃, 33 ℃ and 38 ℃ has been shown by the help of graph. From the results it is concluded that there is large power loss due to non-uniform shading area of cell or solar PV module in series connection but in the parallel connected PV module, there is no large power loss under the shading condition but it may be chance to circulating current due t o variation of power but these circulating current blocked by blocking diodes.***

Keywords: Photovoltaic module, full experimental setup, partial or hard shading, over temperature change on the photovoltaic, the study o ver tilt, and dust.

1. Introduction

Recently mass production of electricity and gene[illegible] ctricity is increasing by solar photovoltaic system one is it does not produce any pollution like CO_2,[illegible] O2 etc and second one is it does not require fossil fuels. The most important of solar photovoltaic module and system, it i s renewable energy. [1]The solar photovoltaic cell or module is directly converted sun's radiation into electrical energy a nd the conversion process of solar photovoltaic cell or modu le depends upon photovoltaic effect. the efficiency of solar p hotovoltaic system depends upon its materials like mono cry stalline, poly crystalline, amorphous solar cell materials and the efficiency of mono crystalline silicon solar cell laborator y about 24% and commercial mono crystalline silicon solar cell has the efficiency 15%, the efficiency of polycrystalline silicon solar cell has 12% and the efficiency of the amorpho us solar cell has 5%. [2]. In this work have two panel which are connected in series and parallel, series connection for the voltage and parallel connection for the current. Solar cell or module produce current that is depend upon solar radiations that fall on the solar photovoltaic cell or module's surface bu t in some case this radiation is blocked due to shading and re duce the power because blocking of solar radiations due to s hading condition. In these days the leading design level of so lar photovoltaic module, then in this cases it is really difficul ties to avoid the hard shading and partial shading of the solar photovoltaic module due to trees, birds, clouds, neighbour h ouse in all the season. . The effect of dust deposition created significant effect and affects the power production and reduc es the efficiency of solar p-v panel. When temperature incre ases then power of p-v cell decreases so loss in efficiency oc curs and also shows the effect of tilt angle and shows accurat e experimental data to show the output power of panel and g raph between different tilt angle and their corresponding po wer.

Experimenta

Table 1: Module Specification

- Material poly crystalline silicon
- Rated maximum power (P_{mpp}) 40W
- Open circuit voltage (V_{oc}) 21.60V
- Short circuit current (I_{sc}) 2.45A
- Rated voltage (V_{mpp}) 17.40V
- Rated current (I_{mpp}) 2.30A
- Isolation/radiation 1000W/m^2
- Module temperature 25℃
- Air mass(AM) 1.5
- Area (each) 0.2m^2

2. Experimental Apparatus

In this study, there are different types of equipment used in t his experiment which are mentioned and defined in the belo w.

2.1 Photovoltaic module**:** In this experimental study, there is a photovoltaic module used which are consists from poly cr ystalline silicon materials and this photovoltaic module direc tly coverts sun's radiations into electrical energy in the form of direct current and this modules are connected in series an d parallel for the experiments and we have taken the photovo ltaic materials like poly crystalline silicon materials for the e xperimental study and this model from the company India S olar Solutions Pvt. Ltd.

2.2 Pot meter: The pot meter is also used in this experimenta l study, for the variation of voltage and current, and the varia tion of pot meter's resistance from 0Ω to 200Ω and the capa

city power of pot meter is 150 watt. The pot meter can be varied from max to min for the open circuit voltage (Voc) and short circuit current(I_{SC}) and we can also be varied the pot meter from minimum to maximum for the short circuit current and for the open circuit voltage(V_{OC}).

2.3 Multi meter: A multi meter is basically used for measure resistance, voltage current, both in ac and dc as well used for specifying type of transistor and continuity of current flow also short circuit. This multi meter is used for calculation open circuit voltage, short circuit current into the circuit for the experiment.

2.4 PIC 152N controller: It is a controller used to read temperature from different types of thermocouple like J, K, T, R, S and RTD PT-100. It could also generate alarm with the respective condition provided. In this experiment I have studied the temperature of photo voltaic plate and the effect of temperature is noted. And here I have used RTD PT-100 for measurement of temperature. It works with 85 to 270 VAC/DC (50 hz or 60hz). And temperature could be measured from -100 ℃ to 850℃.

2.5 RTD PT-100: It is a type of RTD used for temperature measurement made by platinum material it gives us 100Ω resistance at 0℃ temperature and it increase 0.391Ω resistance per ℃. It is a positive temperature coefficient as its resistance increaseswith the increase in temperature. Mostly we use 3-wire RTD for temperature measurement and in which lead resistance compensation is inbuilt. Red wire is main wire with higher polarity and another 2 white wire is for lead compensation and lower polarity

3. Experimental Studies

In the study of experimental setup of photo voltaic cell at a location New Delhi in upcoming winter and different effects like shading, temperature, dust and tilt angle. There P-V and I-V curve at several situations. This study or research will be helped to optimize output power using diodes and it protects from creating a hot spot and reduces the load losses. The graph of shading effect on series connection of both solar photovoltaic modules at 11am, 2 October 2014 with 611w/m^2 without any shading shown below:

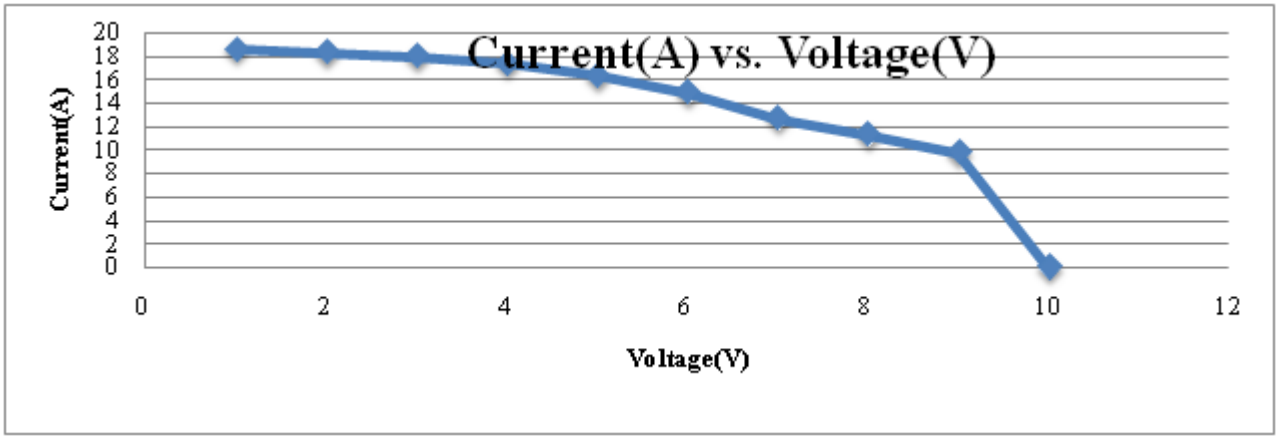

Figure 1: Graph of Current vs. Voltage for no shading on P-V Cell.

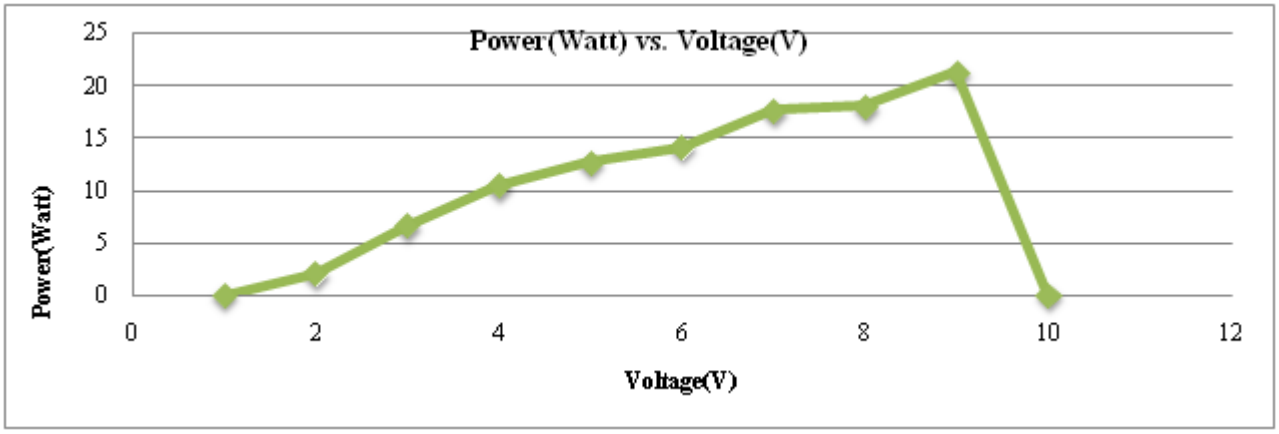

Figure 2: Power vs. Voltage for no shading on P-V Cell.

The graph of shading effect on series connection of both solar photovoltaic modules at 11am, 2 October 2014 with 611w/m^2 with shading 4 cells is shown below:

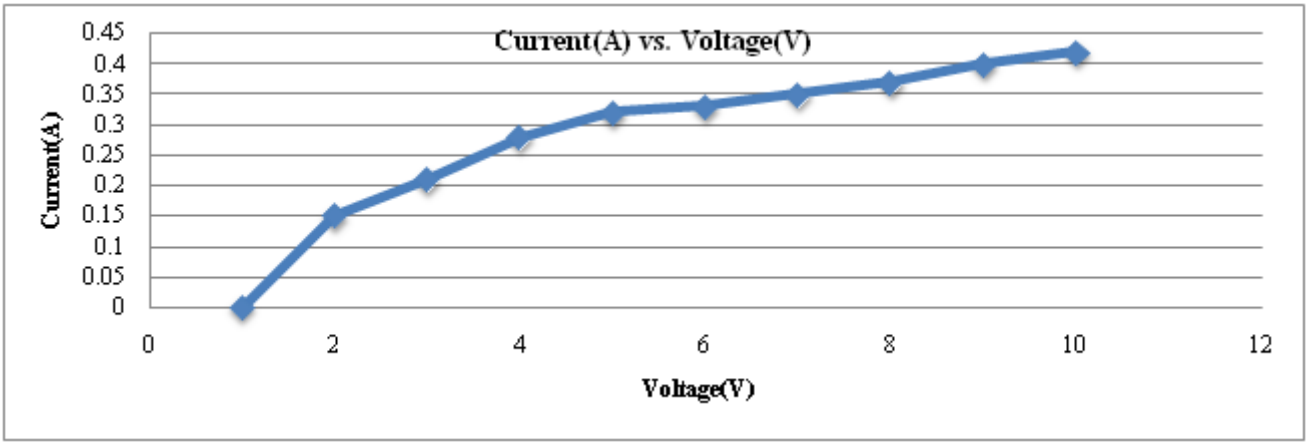

Figure 3: Graph of Current vs. Voltage of 4-cell shading on series connection of the solar photovoltaic module

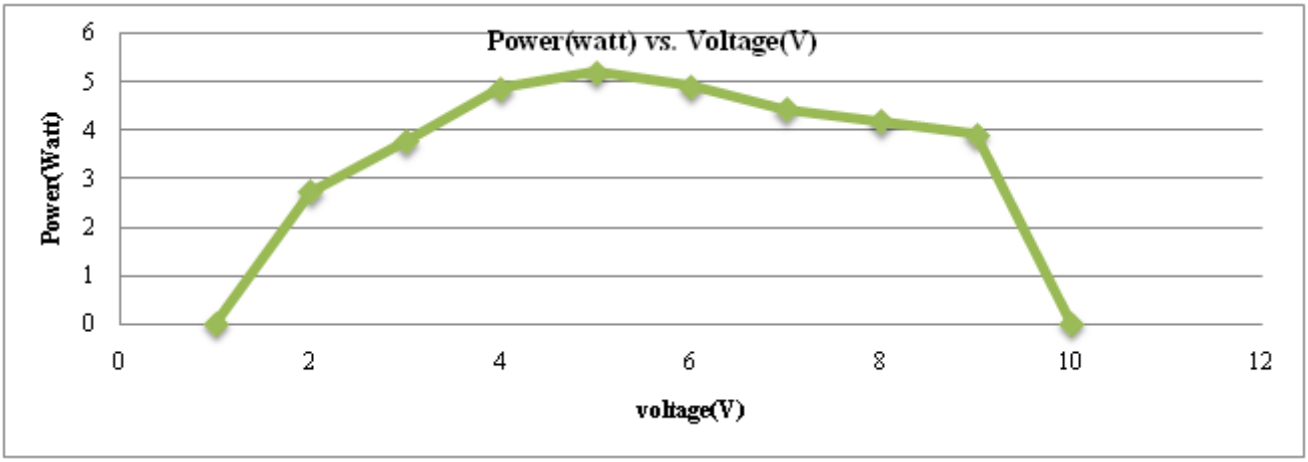

Figure 4: Graph of Power vs. Voltage of 4-cell shading on series connection of the solar photovoltaic module

First we are taking reading at different temperature ranges at constant radiation on 11 October 2014 at 573w/m^2 and at 28℃ a nd 38℃ graph is shown below:

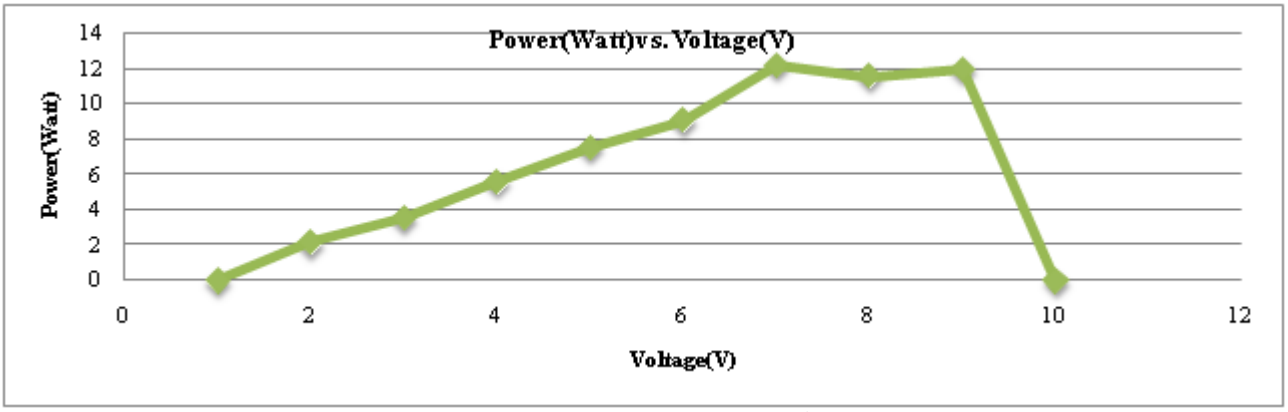

Figure 5: Graph of Power vs. Voltage at 28^0C of P-V Cell.

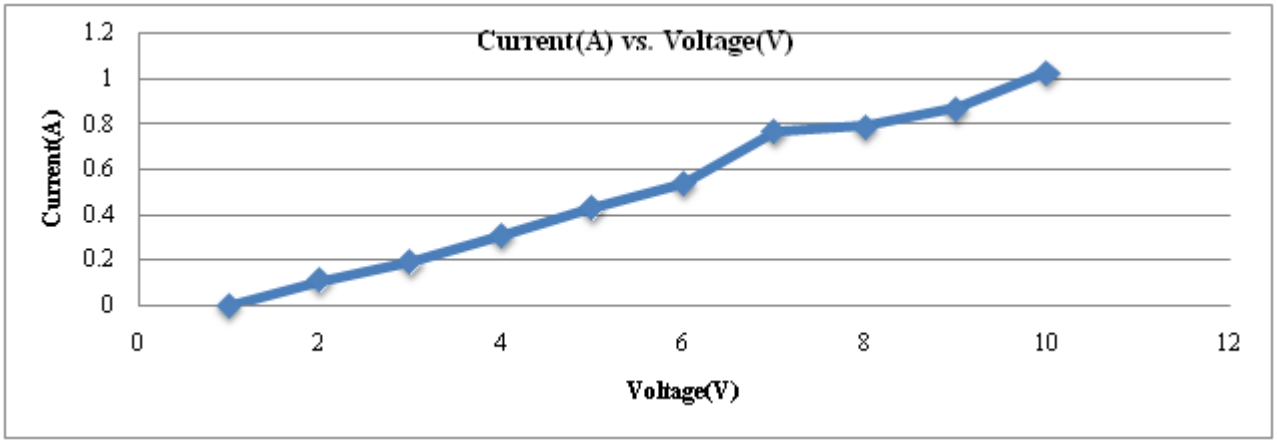

Figure 6: Graph of Current vs. Voltage of at 38^0C of P-V Cell.

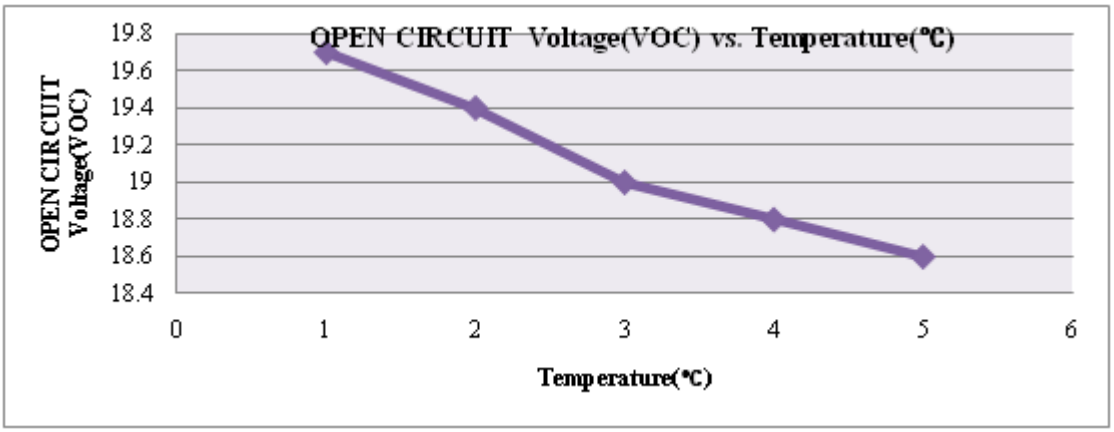

Figure 7: Graph of OPEN CIRCUIT Voltage(V_{OC}) vs. Temperature(℃) of P-V Cell at max power.

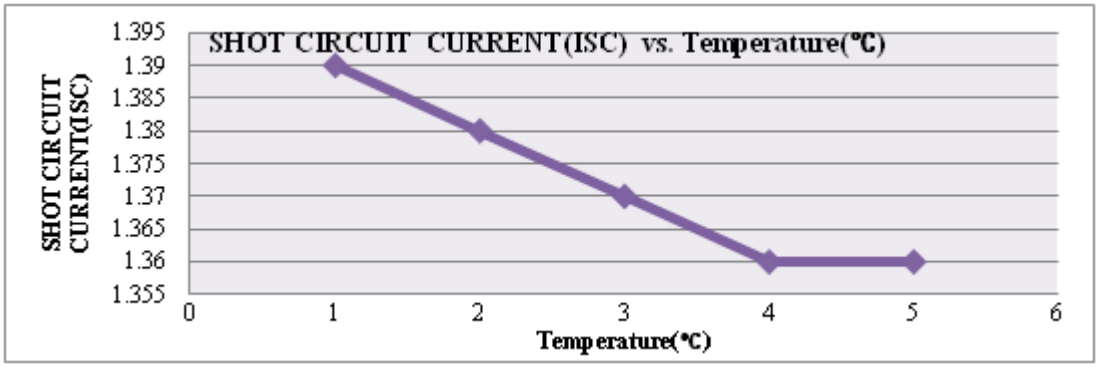

Figure 8: Graph of SHOT CIRCUIT CURRENT(I_{SC}) vs. Temperature(℃) of P-V Cell at max power.

It's the reading at 11:00AM when density was 25g because the panel was totally clean and the experimental data obtained in t he clean panel were compared with the data with the data obtained when some of the dust deposited on the panel.

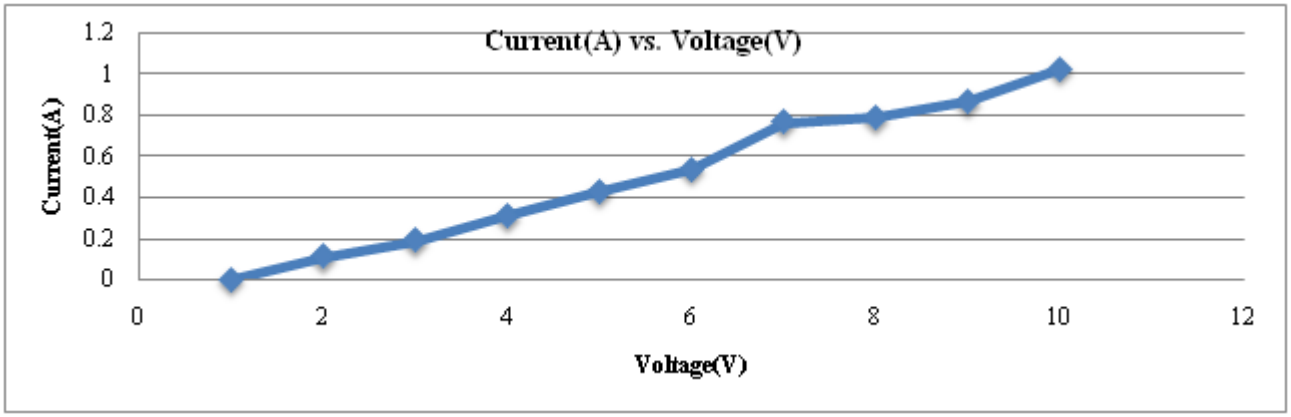

Figure 9: Graph of Current vs. Voltage with 25mg of dust on panel

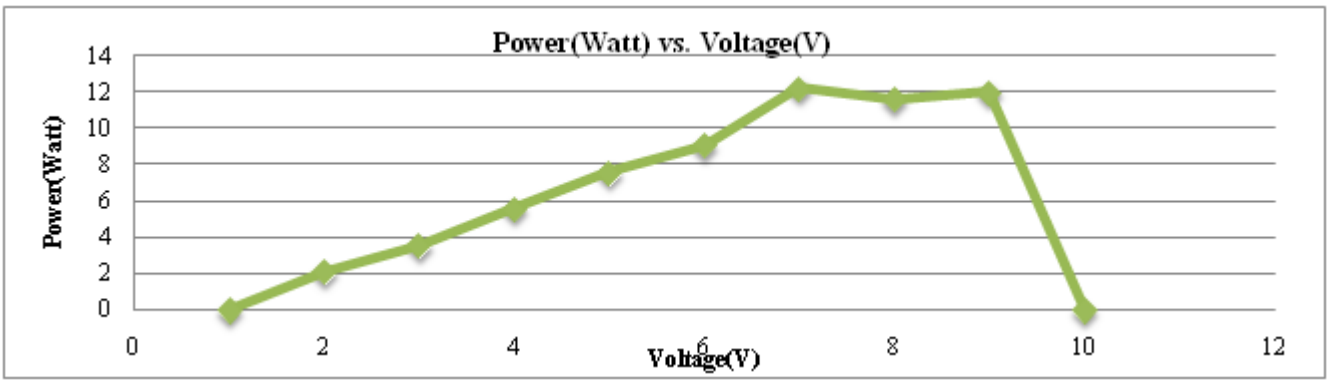

Figure 10: Graph of Power vs. Voltage with 25mg of dust on panel.

It's graph for 1 November 2014 and 24 November 2014, 11:00AM when pot meter is at fixed position and tilt is changed and according to the change in tilt, Voltage and Current changes at different tilt angle is shown below:

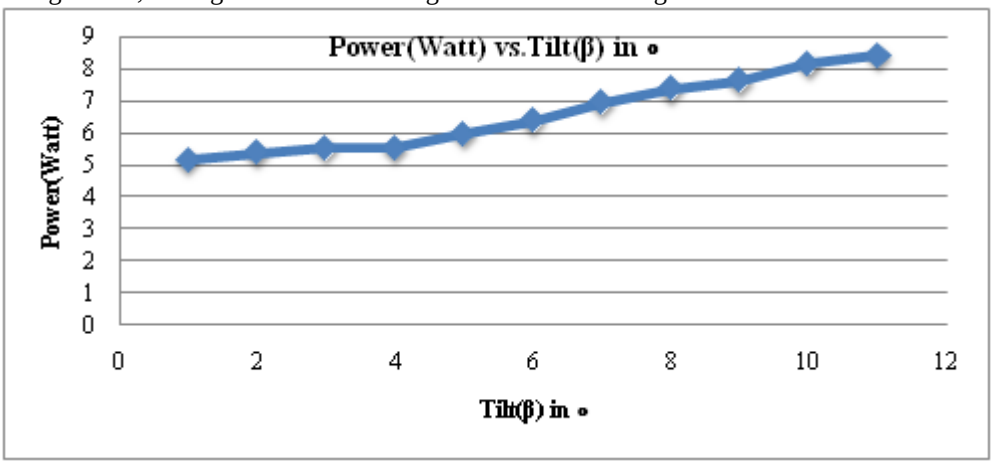

Figure 11: Power vs. Tilt of P-V Cell with 503W/m^2 radiation.

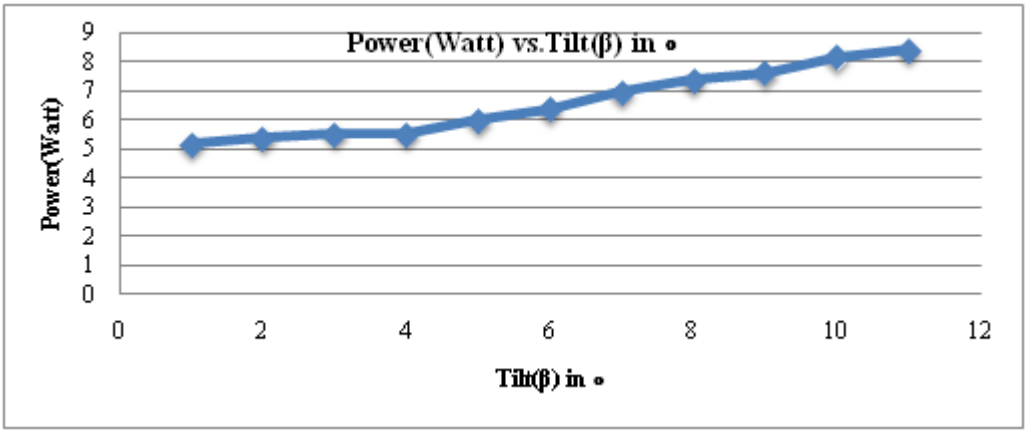

Figure 12: Power vs. Tilt of P-V Cell with 477W/m^2 radiation.

4. Result

In this thesis effects of cloud, temperature change, dust over the panel and tilt angle of Photovoltaic panel has been discussed and studies. This study is not for the hot summer but it is for upcoming winter i.e. from 1st of October 2014 to 30th of November 2014. It is cleared that the reduction of power due to shaded area or shaded cell of solar photovoltaic module and this investigation was done by experimental data and P-V and I-V curve. From the results it is concluded that there is large power loss due to non-uniform shading area of cell or solar PV module in series connection but in the parallel connected PV module, there is no large power loss under the shading condition but it may be chance to circulating current due to variation of power but these circulating current blocked by blocking diodes. Study over temperatures at 28℃, 33℃ and 38℃ has been shown by the help of graph we can see initially the temperature increases then the overall efficiency is also increases while when at higher temperature range acquire then curve of efficiency is saturated and it start bend downward and efficiency started decreasing. In our experiment, according the data we have obtained and analysed, we are able to conclude that there is significant effect of dust deposition on the performance of solar p-v panel. In the experiment we have found that as the density of dust deposition on the panel i

ncreases, the production of power reduces. Also the study ov er tilt has been made as maximum power is when the tilt ang le is between 45° to 55° as it allows maximum beam radia tion to fall on the photovoltaic that provides the maximum p ower as output.

5. Conclusion

For the small scale power plant or power generating station of solar photovoltaic system we can be used diodes because i t is less costly then power optimizer and other equipment. W e can also reduce the shading effect from solar cells by using bypass diodes for each cell. We can use waste water as a wa ter sprinkle irrigation purpose and much agriculture purpose application like water pump. In future we can use other equi pment for efficiency improvement technique like, thin plasti c transparent sheet, this transparent sheet maintain the tempe rature and improve the output efficiency of solar panel. Ther e should be some tilt angel on the solar p-v panel so that nat ural cleaning by wind and rain can be made possible. Coatin g of some dirt repellent material can be used on transparent glass cover, which can repel dust particle from the surface. Observations for tilt angle should be taken as correct as poss ible.

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