Simulation Diagram:

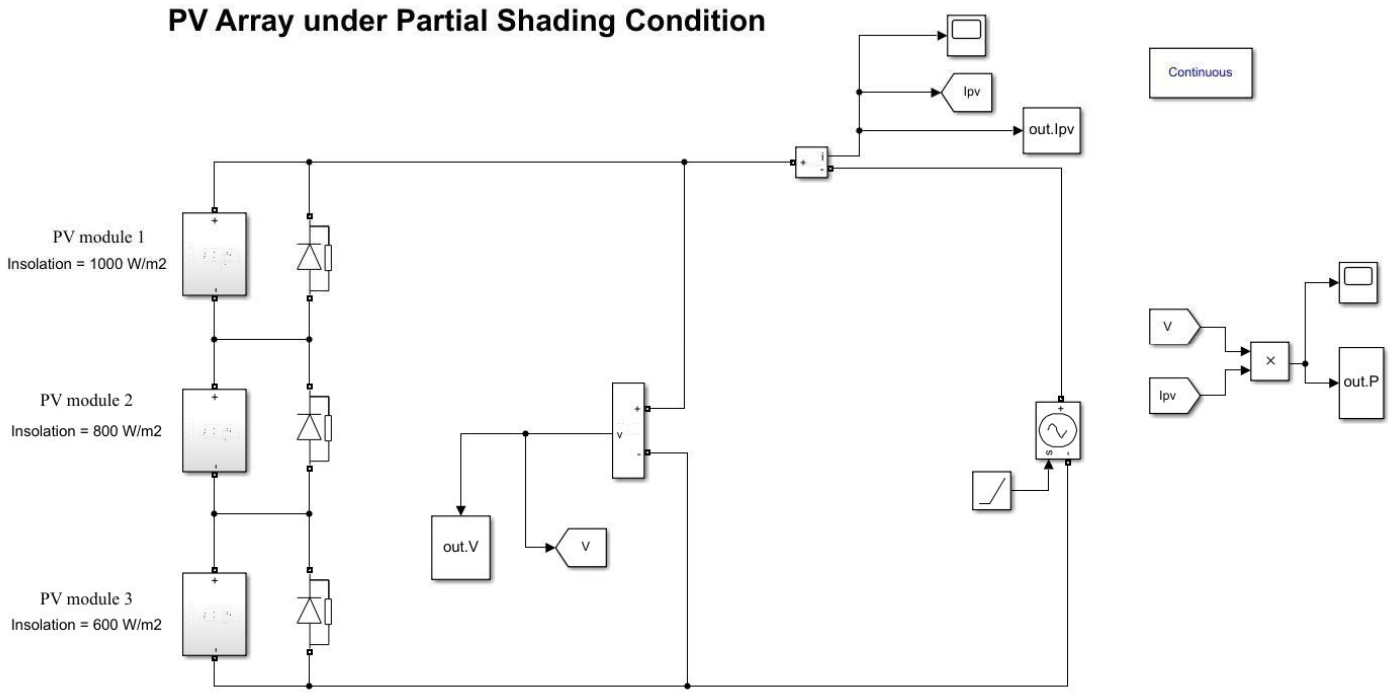

Fig 5. Final model for simulation of PV array under partial shading condition

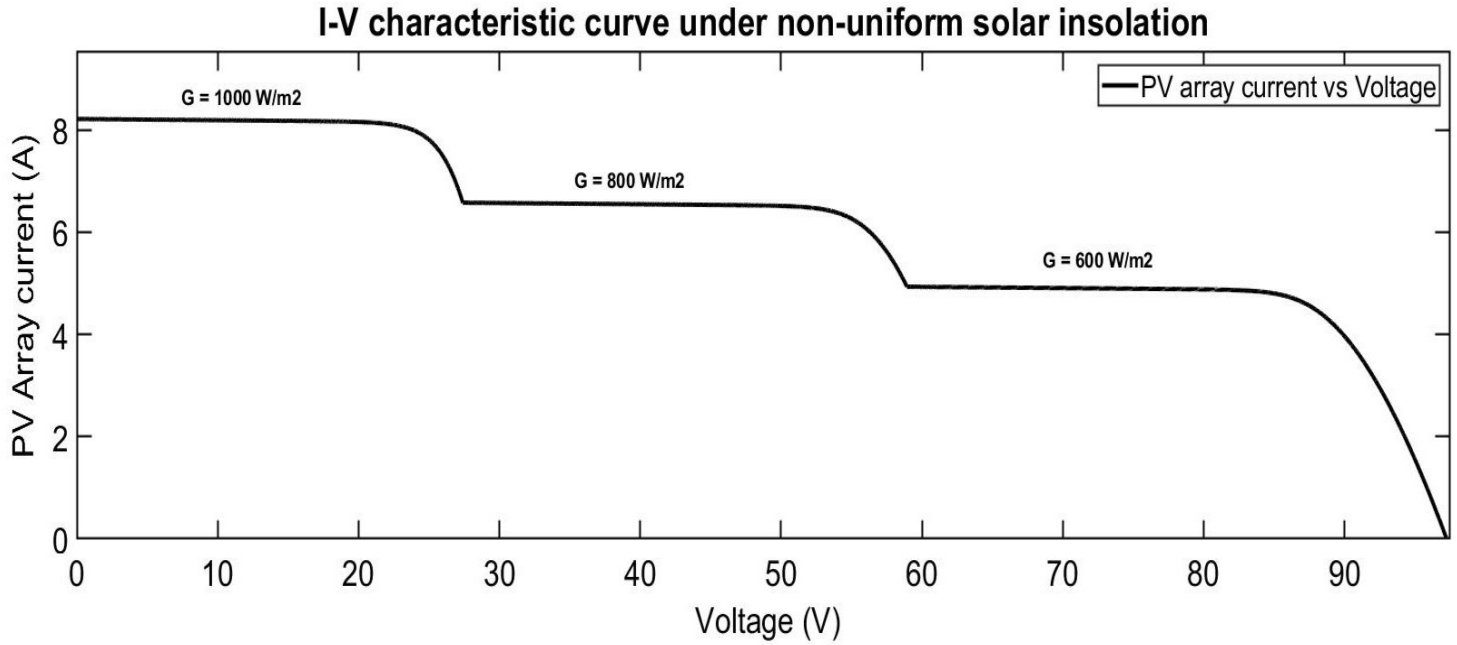

Fig 6. I-V characteristics curve under non – uniform solar insolation

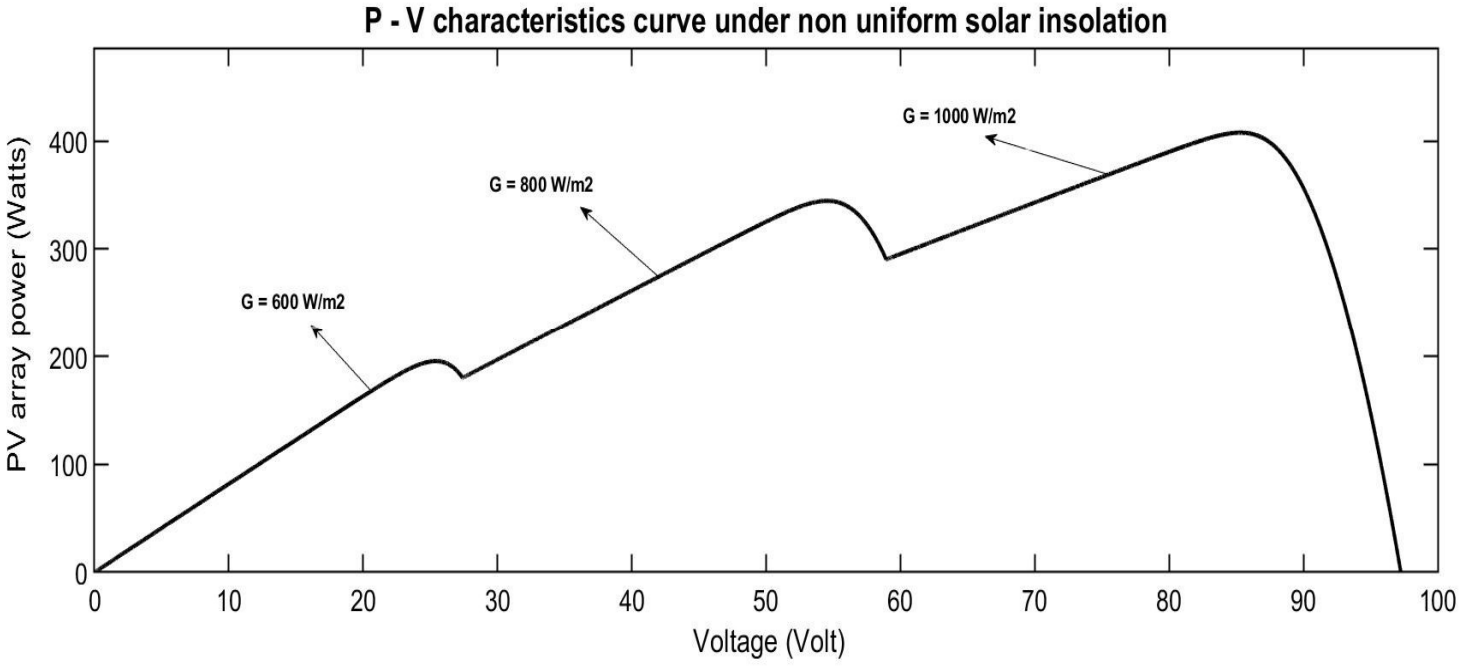

Fig 7. P – V characteristics curve under non – uniform solar insolation

Experiment 3

Aim of the Experiment: To study the I – V and P – V characteristics of a PV array under partial shading conditions.

Objectives:

- Design of series connection of PV modules with by-pass diode.
- To obtain I – V and P – V characteristics of a PV array under partial shading conditions.

Theory:

When solar insolation is uniform, the PV array's P -V characteristic has a singular peak. In practice, however, not all PV modules may receive equal insolation. A nearby tree, a cloud in motion, or other objects may shade a portion of the PV module. This is referred to as a partial shading. As a result, the PV modules in the PV array will not produce equal current. When a particular module receives less sunlight than its neighboring modules, a module that generates a higher current forces a module that generates a lower current to operate at a higher current. As a result, the shaded cell may reach the operating region with negative voltage. This may result in thermal degradation of the PV cell, also known as the hotspot effect. The hotspot effect is depicted in Figure 3. This effect can be prevented by placing a bypass diode across certain module cells. In practice, the bypass diode is positioned between fifteen to twenty series-connected cells. When the reverse saturation voltage of a PV cell exceeds the cut-in voltage of a diode, the diode enters forward bias, thereby bypassing the corresponding module. Figure 2 depicts three PV modules connected in series, each with a bypass diode.

In Fig.4, a bypass diode is connected across a PV module. Here, a single cell of the PV module is shaded by nearby objects.

The bypass diode will activate when

$$V_2 - \sum_{1}^{n} v_i \geq V_D$$

Where i is the number of PV cell.