

T.Y.B.Sc (Physics).

Elective-I : Renewable Energy Sources.

Module-3 :- Photovoltaic Systems.

Problems

Q.1 Calculate the fill factor of solar cell using following data,

$$V_{oc} = 600 \text{ mV}, I_{sc} = 60 \text{ mA}, V_m = 500 \text{ mV}, I_m = 40 \text{ mA}.$$

Solⁿ :- Given, $V_{oc} = 600 \text{ mV}$,
 $I_{sc} = 60 \text{ mA}$,
 $V_m = 500 \text{ mV}$,
 $I_m = 40 \text{ mA}$
 $F.F. = ?$

We know that, $F.F. = \frac{V_m \times I_m}{V_{oc} \times I_{sc}}$

$$\therefore F.F. = \frac{40 \text{ mA} \times 500 \text{ mV}}{600 \text{ mV} \times 60 \text{ mA}}$$

$$\therefore F.F. = \frac{4 \times 5}{6 \times 6} = \frac{20}{36} = \frac{5}{9}$$

$$\therefore F.F. = 0.555 \approx \underline{0.6}$$

Q.2 . Calculate the efficiency of solar cell using the following data.

Given, $V_{oc} = 400 \text{ mV}$, $I_{sc} = 40 \text{ mA}$, $F.F. = 0.7$, Input power of the cell = $6 \times 10^{-2} \text{ W}$

Solⁿ :- Given, $V_{oc} = 400 \text{ mV}$,
 $I_{sc} = 40 \text{ mA}$,
 $F.F. = 0.7$

(Pin) I/P power = $6 \times 10^{-2} \text{ W}$
Efficiency (η) = ?

We have the efficiency of solar cell is given by,

$$\text{Efficiency } (\eta) = \frac{\text{Maximum o/p power of the solar cell}}{\text{I/P power of the solar cell}}$$

$$\text{i.e. } \eta = \frac{P_{\max}}{P_{\text{in}}}$$

$$\text{But } P_{\max} = V_m \times I_m \quad \therefore \eta = \frac{V_m \times I_m}{P_{\text{in}}} \quad \text{--- (1)}$$

Also we have ,

$$\text{F.F.} = \frac{V_m \times I_m}{I_{\text{sc}} \times V_{\text{oc}}}$$

$$\Rightarrow V_m \times I_m = \text{F.F.} \times I_{\text{sc}} \times V_{\text{oc}}$$

$$\therefore V_m \times I_m = 0.7 \times 40 \text{ mA} \times 400 \text{ mV}$$

$$\therefore V_m \times I_m = 0.7 \times 40 \times 400 \times 10^{-6} \text{ AV}$$

$$V_m \times I_m = 11200 \times 10^{-6} \text{ AV}$$

$$V_m \times I_m = 1.12 \times 10^{-2} \text{ AV} = 1.12 \times 10^{-2} \text{ W}$$

Substitute this value in eqⁿ (1), we get .

$$\eta = \frac{1.12 \times 10^{-2} \text{ W}}{P_{\text{in}}} = \frac{1.12 \times 10^{-2} \text{ W}}{6 \times 10^{-2} \text{ W}}$$

$$\therefore \eta = 0.1866 \text{ W/W}$$

$$\boxed{\therefore \eta = 0.187}$$

$\therefore$ The efficiency of solar cell is = 0.187 .

Q.3. Calculate the maximum power of solar cell using the following data .

$$I_{\text{sc}} = 80 \text{ mA}, V_{\text{oc}} = 400 \text{ mV}, \text{F.F.} = 0.7$$

Solⁿ :- Given, $I_{\text{sc}} = 80 \text{ mA}, V_{\text{oc}} = 400 \text{ mV},$

$$\text{F.F.} = 0.7,$$

$$P_{\max} = ?$$

We have, The maximum power of solar cell is given by ,

$$P_{\max} = I_{\text{sc}} \times V_{\text{oc}} \times \text{F.F.}$$

$$P_{\max} = 80 \text{ mA} \times 400 \text{ mV} \times 0.7$$

$$\therefore P_{\max} = 80 \times 400 \times 0.7 \times 10^{-6} \text{ W}$$

$$= 22400 \times 10^{-6} \text{ W}$$

$$\boxed{P_{\max} = 2.24 \times 10^{-2} \text{ W}}$$