Series N° 02

Exercise 1: Effect of Temperature on Photovoltaic Cell Performance

Problem:
A silicon-based photovoltaic cell has an open-circuit voltage (Voc) of 0.6 at a reference temperature of 25∘C (298 K). The temperature coefficient of voltage is −0.002 V/°C . If the temperature of the cell increases to 45∘C (318 K), calculate:

- The new open-circuit voltage at 45∘C.

- If the current generated by the cell is 5 A, calculate the power output at both temperatures.

Exercise 2: Impact of Temperature on Efficiency of a Photovoltaic Cell

Problem:
A photovoltaic cell has an efficiency of 18% at a reference temperature of 25∘C. The temperature coefficient for efficiency is −0.005 %/∘C. If the temperature of the cell increases to 35∘C, calculate:

1. The new efficiency at 35∘C.
2. If the solar irradiance is 1000 W/m^2 and the area of the solar cell is 2 m^2 , calculate the energy output of the cell at both temperatures for 5 hours of sunlight.

Exercise 3 : Solar Irradiance and Temperature Effects on PV System Performance

Problem:

A photovoltaic (PV) module has the following characteristics at a reference temperature of 25∘ C and solar irradiance of 1000 W/ m^2:

- Open-circuit voltage (Voc): 0.65 V
- Short-circuit current (Isc 6.5A)
- Efficiency (η): 18% (0.18)
- Temperature coefficient for the open-circuit voltage: βV=−0.0025 V/°C
- Temperature coefficient for efficiency: α=−0.005 %/°C

- **Calculate the new open-circuit voltage** of the PV module when the temperature increases from 25∘C to 35∘C

- **Calculate the new short-circuit current** assuming that the current increases by 0.1% per °C rise in temperature (typical for many PV modules).

- **Determine the new efficiency** of the module when the temperature increases to 35∘ C.

- **Calculate the energy output** of the PV module for 5 hours of sunlight at both 25∘ C and 35∘C35∘C, assuming the solar irradiance remains at 1000 W/ m2

Exercise 4: Power Generation in a Low Irradiance Region

Problem: In a region where the average solar irradiance is 600 W/m², you need to generate 2.5 kW of power. The solar panels have an efficiency of 20%.

* Calculate the area required ?

Exercise 5: Calculating the Efficiency of a Photovoltaic Cell

Problem:

A photovoltaic (PV) cell has the following characteristics:

- Open-circuit voltage (Voc) = 0.60 V
- Short-circuit current (Isc) = 5 A
- Area of the PV cell (A) = 1 m²
- Solar irradiance (G) = 1000 W/m²

Calculate the efficiency (η) of the photovoltaic cell under standard test conditions (STC).

Exercise 6: Power Output of a Photovoltaic Cell at Different Temperatures

Problem:

A photovoltaic (PV) cell has the following characteristics at 25°C:

- Open-circuit voltage (Voc= 0.60 V)
- Short-circuit current (IscI) = 5 A
- Efficiency (η) = 18% (0.18)
- The temperature coefficient for open-circuit voltage is $\beta V = -0.003$ V/°C
- The temperature coefficient for short-circuit current is $\beta I = +0.004$ A/°C
- The temperature of the PV cell increases to 35°C.

Calculate the new power output of the cell at 35°C.