SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF MECHANICAL ENGINEERING

19MEZ402 Solar Photovoltaics Fundamentals And Technology

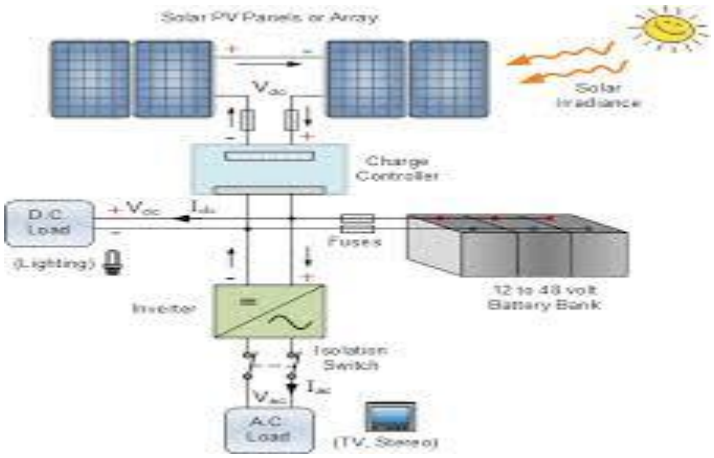
UNIT 2-STAND ALONE PV SYSTEMS

Schematics and Components

A Stand-Alone Photovoltaic (PV) System is designed to operate independently from the grid, providing electricity to remote locations or for specific applications. Here's an overview of the schematics and key components involved:

Schematics

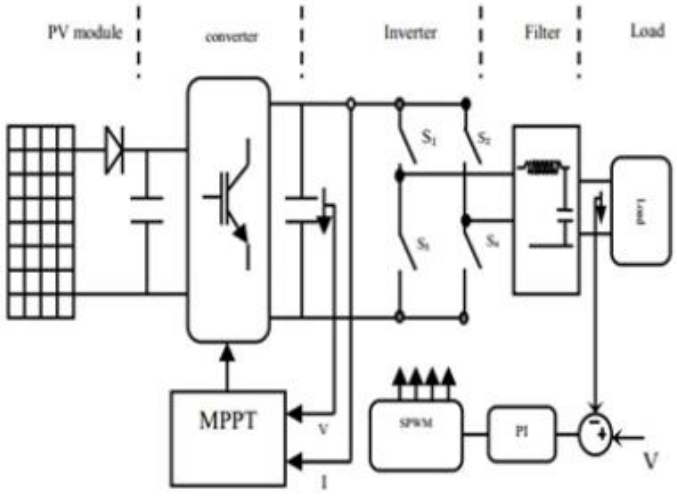
A typical stand-alone PV system can be represented with the following components:



1. **Solar Panels (PV Modules):**
   - **Function:** Convert sunlight into DC electricity.
   - **Placement:** Installed at an optimal angle to maximize solar energy capture.
2. **Charge Controller:**
   - **Function:** Regulates the voltage and current coming from the solar panels to protect the batteries from overcharging.
   - **Types:**
     - PWM (Pulse Width Modulation)
     - MPPT (Maximum Power Point Tracking)

3. **Battery Bank:**
    - **Function:** Stores the DC electricity generated by the PV panels for use when sunlight is not available (e.g., at night or during cloudy weather).
    - **Types:**
        - Lead-Acid Batteries (Flooded, AGM, Gel)
        - Lithium-Ion Batteries
4. **Inverter:**
    - **Function:** Converts the stored DC electricity from the battery bank into AC electricity, which can be used to power standard household appliances.
    - **Types:**
        - Pure Sine Wave Inverter
        - Modified Sine Wave Inverter
5. **Load (Appliances):**
    - **Function:** Devices that consume electricity (e.g., lights, fans, refrigerators).
    - **AC or DC Loads:** Depending on whether the appliances are designed for AC or DC power.
6. **Mounting Structure:**
    - **Function:** Supports the solar panels, ensuring they are securely positioned for optimal sun exposure.
    - **Types:** Ground-mounted or rooftop-mounted systems.
7. **Wiring and Circuit Protection:**
    - **Function:** Connects all components and includes safety devices like fuses, circuit breakers, and disconnect switches to protect the system from electrical faults.

Detailed Schematic



Components Overview

1. **PV Panels:**
    - Typically made from silicon, either monocrystalline or polycrystalline.
    - Rated by power output in watts (W) based on their efficiency and surface area.
2. **Charge Controller:**
    - Ensures the batteries are charged efficiently and prevents overcharging.
    - MPPT controllers are more efficient as they adjust the input power to maximize energy harvesting.
3. **Battery Bank:**
    - The size and type depend on the energy storage needs and the specific application.
    - Proper battery management is crucial for extending the lifespan of the battery bank.
4. **Inverter:**
    - Converts DC from batteries to AC, allowing the system to power regular appliances.
    - Pure sine wave inverters are preferred for sensitive electronics, while modified sine wave inverters are less expensive but may not be compatible with all devices.
5. **Load:**
    - Can include lighting, small electronics, and essential household appliances.
    - Energy-efficient appliances are recommended to maximize the utility of the stored energy.
6. **Mounting Structure:**
    - Should be durable and designed to withstand local environmental conditions.
    - Proper orientation and tilt angle are critical for maximizing solar energy capture.
7. **Wiring and Circuit Protection:**
    - Use appropriately rated wires to handle the expected current.
    - Circuit protection devices help prevent damage from electrical overloads or short circuits.

This is a basic overview. Specific designs may vary based on the location, load requirements, and available solar resources.