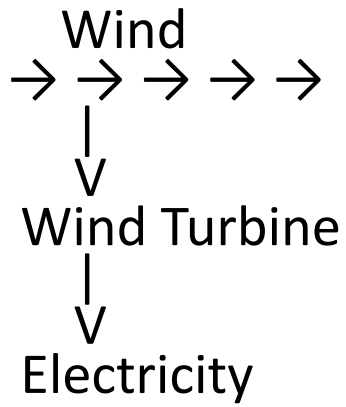
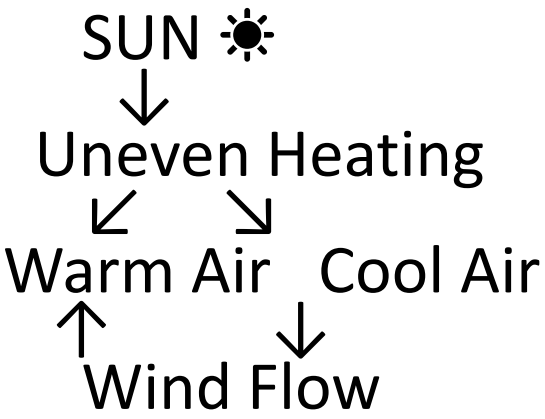
UNIT-III
WIND ENERGY

Introduction to Wind Energy

- **What is Wind Energy?**
- Wind energy is the energy obtained from moving air.
- It is a clean and renewable source of energy.
- Wind turbines convert wind energy into electrical energy.
- One of the fastest-growing renewable energy technologies.
- **Diagram:**
- 

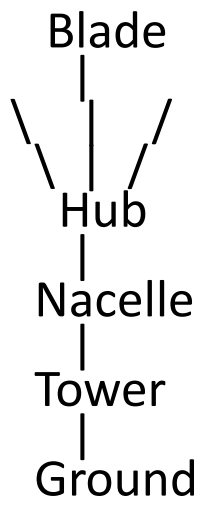
Formation of Wind

- **How is Wind Formed?**
- The Sun heats the Earth's surface unevenly.
- Warm air rises and cool air moves in to replace it.
- This movement of air creates wind.
- **Diagram:**
- 

Principle of Wind Energy

- **Working Principle**
- Wind possesses kinetic energy.
- Turbine blades capture wind energy.
- Rotor rotates and drives a generator.
- Generator produces electricity.
- **Diagram:**
- Wind → Blades → Rotor
  ↓
  Generator
  ↓
  Electricity

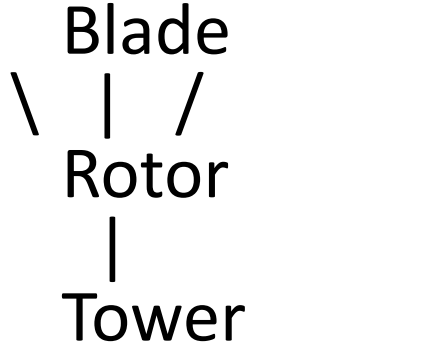
Components of a Wind Turbine

- **Main Components**
- Rotor Blades
- Hub
- Nacelle
- Gearbox
- Generator
- Tower
- Controller
- **Diagram:**
- 

Types of Wind Turbines

- **Based on Axis of Rotation**
- **Horizontal Axis Wind Turbine (HAWT)**
- Most common type
- High efficiency
- **Vertical Axis Wind Turbine (VAWT)**
- Operates in any wind direction
- Suitable for urban areas
- **Diagram:**
- HAWT VAWT

Horizontal Axis Wind Turbine

- **Features**
- Rotor axis parallel to ground.
- High power output.
- Widely used in wind farms.
- **Diagram:**
- 

Vertical Axis Wind Turbine

- **Features**
- Rotor axis perpendicular to ground.
- Works irrespective of wind direction.
- Easier maintenance.

Wind Power Equation

- **Power Available in Wind**
- $P = \frac{1}{2}\rho A V^3$
- Where:
- P = Power (W)
- ρ = Air density (kg/m³)
- A = Swept area (m²)
- V = Wind velocity (m/s)