**FUNDAMENTALS OF ELECTRONICS**

1. RESISATANCE
2. CAPACITANCE
3. INDUCTANCE
4. POWER
5. ENERGY

### ****Resistance :****

**Definition**: Opposition offered by a material to the flow of electric current.

**Unit**: Ohm (Ω)

**Formula**:

* **V=IR => I=V/R**

Where:

V = Voltage (Volts)

I = Current (Amps)

**Real-life example**: Resistors in a circuit to reduce or control current.

**Symbol** in circuit: zig-zag line

**Ohm’s Law** is based on this.

### ****Capacitance (C):****

**Definition**: The ability of a device to store electrical energy in an electric field.

**Unit**: Farad (F)

**Formula**:

* **C=Q/V**​

Where:

Q: Charge (Coulombs)

V: Voltage (Volts)

**Real-life example**: Capacitors in fans for speed control.

**Symbol** in circuit: || (two parallel lines)

### ****Inductance (L):****

**Definition**: The property of a conductor by which a change in current produces a voltage (self-induced).

**Unit**: Henry (H)

**Formula**:

* **V=L.dI/dt**​

Where:

L: Inductance

dI/dt: Rate of change of current

**Real-life example**: Inductors used in SMPS, transformers, and motor windings.

**Symbol** in circuit: Coiled wire

### ****Power (P):****

**Definition**: The rate at which electrical energy is consumed or converted.

**Unit**: Watt (W)

**Formula**:

* **P=V⋅I**

Also:

* **P=I^2⋅R=V^2/R**

**Real-life example**: A 60W bulb consumes 60 watts of power.

**Measured using**: Wattmeter

### ****Energy (E):****

**Definition**: The capacity to do work; in electronics, it's the total power consumed over time.

**Unit**: Joule (J)

**Formula**:

* **E=P⋅t**

Where:

P: Power

t: Time in seconds

**Real-life example**: Electric bills are based on energy usage (kWh).

## ****Voltage, Current, Electron & Proton****

### ****Voltage (V)**** – ****Electrical Pressure:****

**Definition**: Voltage is the **force or pressure** that pushes electrons through a conductor.

**Unit**: Volt (V)

**Also called**: **Potential difference** or **electromotive force (EMF)**

**Formula**:

* **V=IR**

**Example**: A 9V battery gives 9 volts of push to electrons.

**Think of it like**: Water pressure in a pipe — more pressure, faster water flow.

### ****Current (I)**** – ****Flow of Electrons:****

**Definition**: Current is the **flow of electric charge** (electrons) in a circuit.

**Unit**: Ampere (A)

**Formula**:

* **I=Q/t**​

Where:

Q = Charge (Coulombs)

t = Time (seconds)

**Types**:

**DC (Direct Current)** – flows in one direction (battery)

**AC (Alternating Current)** – changes direction (home electricity)

**Think of it like**: Flow of water in a pipe — current is how fast water (electrons) moves.

### ****Electron (e⁻)**** – ****Negative Charge:****

* **Definition**: A **tiny negatively charged particle** that moves in a wire to create electricity.
* **Charge**: −1.6×10^−19 C
* **Mass**: Very tiny – 9.1×10^−31 kg
* **Location**: Outside the nucleus of an atom (in shells/orbitals)
* **In circuits**: Electrons are the main **carriers of electric current**.

### ****Proton (p⁺)**** – ****Positive Charge:****

* **Definition**: A **positively charged particle** found inside the nucleus of an atom.
* **Charge**: +1.6×10^−19 C
* **Mass**: Heavier than electrons – 1.67×10^−27 kg
* **In circuits**: Protons don’t move — only electrons move in wires.

| **Property** | **Electron (e⁻)** | **Proton (p⁺)** |
| --- | --- | --- |
| Charge | Negative (-) | Positive (+) |
| Location | Outer shell of atom | Inside nucleus |
| Mass | Very light | Much heavier |
| Role in Current | Moves and carries current | Does not move |