Electric Circuits and Networks

------BASICS-----

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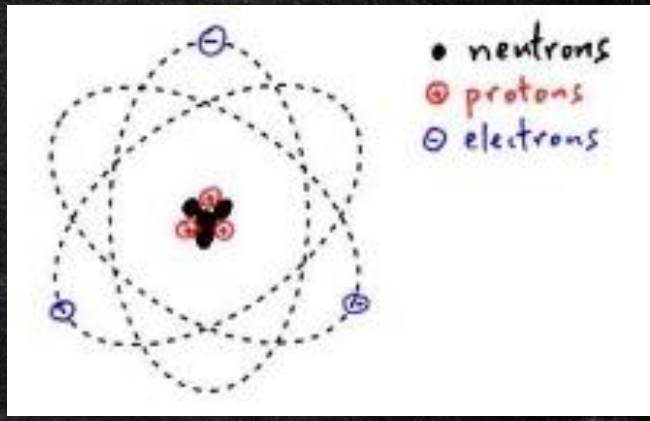
OVERVIEW

- What's
  - Voltage
  - Current
  - Energy
  - Power
- Network Elements
- Parameters of Electric circuit
- Conclusion

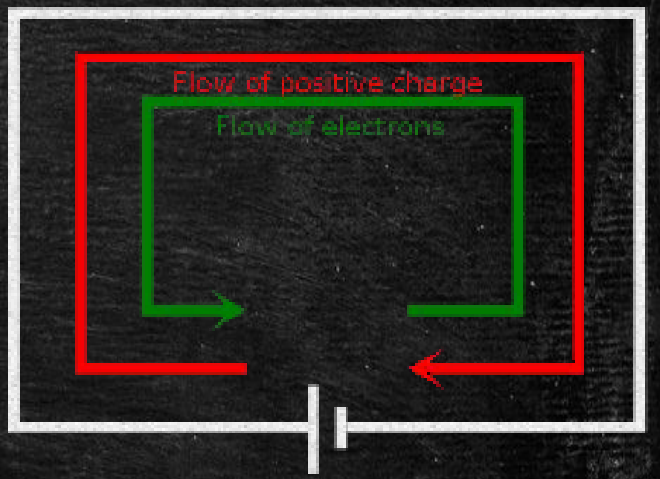
VOLTAGE



- Always a force of attration exists between +ve and -ve charges in an atom.
- The energy required to overcome this force and move the charge through specific distance is called poterntial energy.
- The difference in Potential Energy is called **Potential Difference (Electrical term: VOLTAGE)**

$$\mathbf{V} = \frac{W\ (energy)}{Q(Charge)}$$

CURRENT

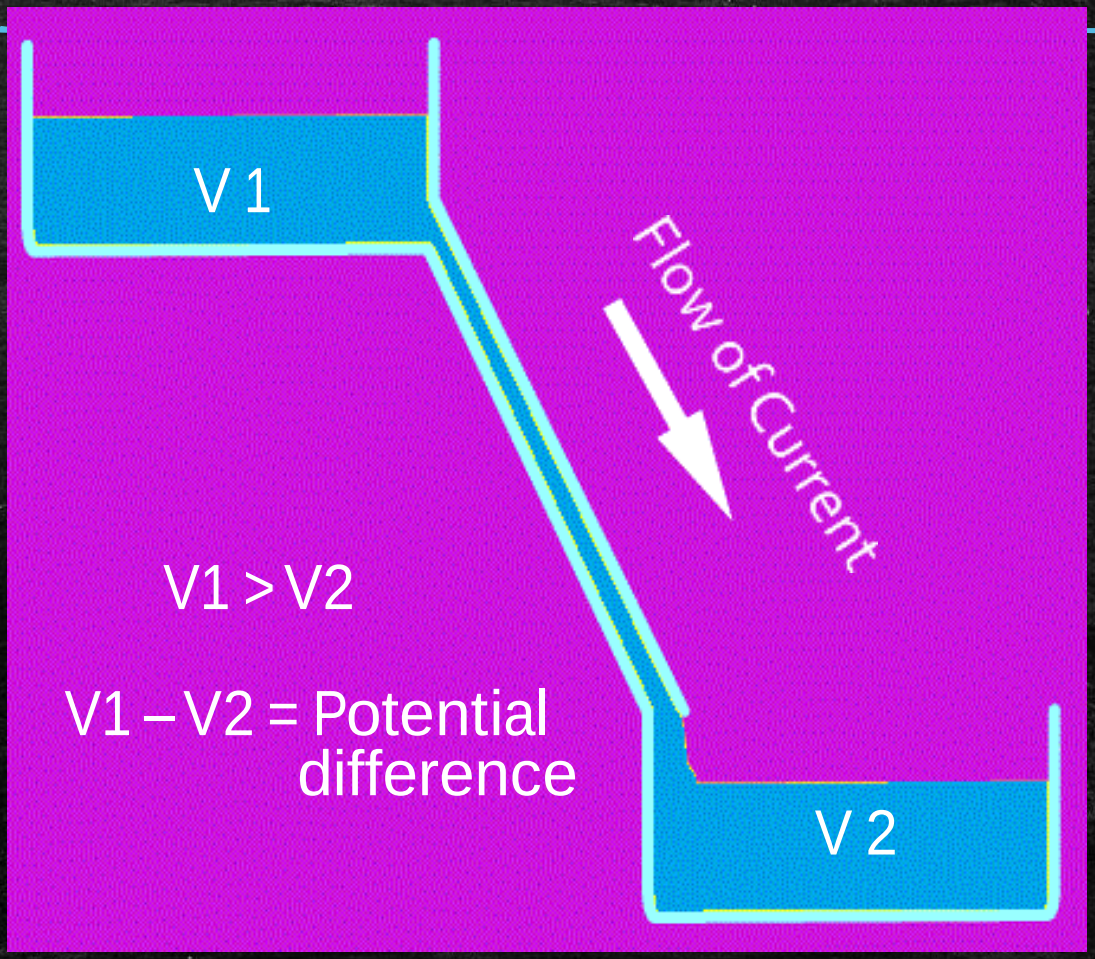


- The rate of flow of electrons in a conductive or semiconductive material.
- It is measured by the number of electrons flow past a point in unit time.

$$I = \frac{Q(Charge)}{t\ (time)}$$

NOTE : 1A = 1COULOMB/sec = $6.25\ X\ 10^{28}\ e^{-}$s /sec

ANALOGY



Energy and Power

- Energy - Capacity for doing work

  (measured in terms of **Joules**)

- Power - Rate of change of energy in unit time

  (measured in terms of **Watts**)

$$P = \frac{W\ (Energy)}{t\ (time)}$$

Note : **1W = 1J / Sec**

NETWORK ELEMENTS

We can classify network elements into 4 types:

1. Active / Passive Elements
2. Bilateral / Unilateral Elements
3. Linear / Non-Linear Elements
4. Lumped / Distributed Elements

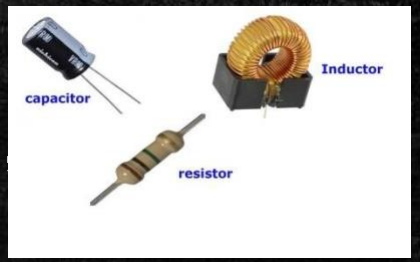
ACTIVE AND PASSIVE ELEMENTS

The Active elements have the capabilty to deliver average power greater than zero for infinite period of time to the connected devices.

Eg: Ideal power sources, Battery, etc.,

Passive elements = $Active\ elements^{-1}$

It consumes or dissipate the energy stored in the circuit.

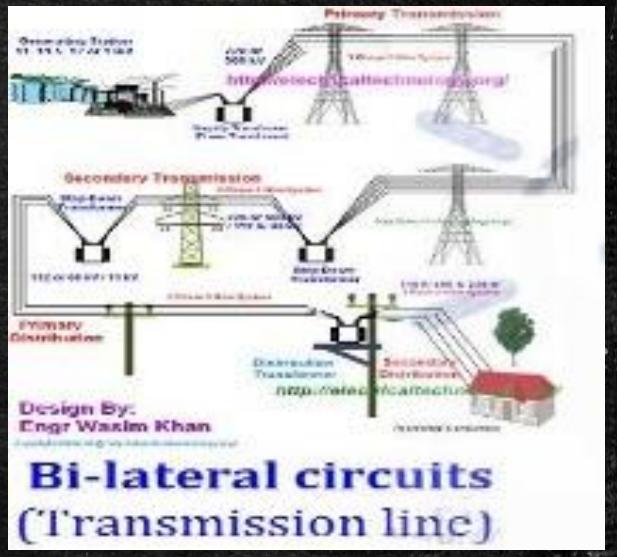


Eg: Resistors, Inductors, Capacitors, etc.,

BILATERAL AND UNILATERAL

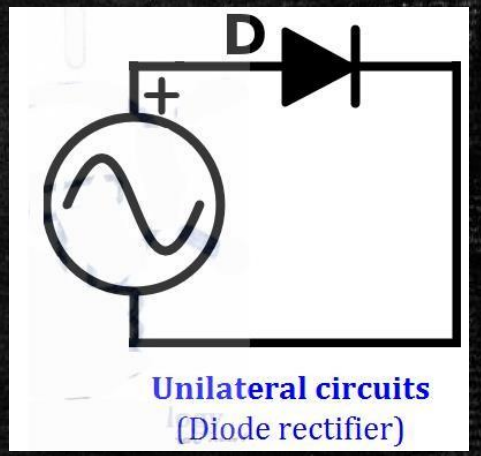
- The bilateral elements have same V-I relationship for current flow in either direction.

  Eg : Any conducting wire, Resistors.



- Unilateral Elements = $\text{Bilateral elements}^{-1}$

  Eg : Vaccum diodes, Silicon diodes, rectifiers, etc.,



LINEAR AND NON-LINEAR

- Linear elements have linear V-I relationship (i.e. Straight line) passing through origin.
- Linear elements obeys superposition theorem.

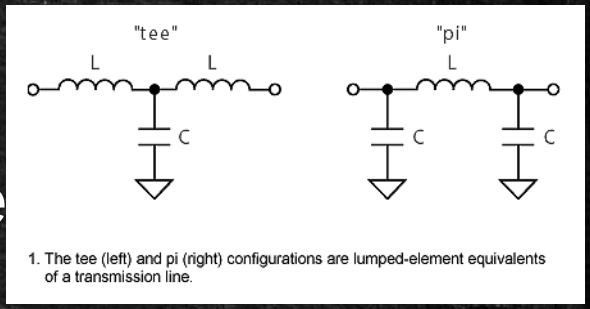
Eg: Resistors

- Non-Linear Elements = $Linear\ elements^{-1}$

Eg: SCR, Triac

LUMPED AND DISTRIBUTED

- Small in size and simultaneous action takes place for any given cause at same time of instant.



1. The tee (left) and pi (right) configurations are lumped-element equivalents of a transmission line.

(size is very small compared to wavelength of signal applied) Eg: R,L,C

- Distributed Elements are not electrically separable for any analytical purpose.

Eg: Transmission line has its distributed R,L,C throughout its entire length.

PARAMETERS

- Three major parameters used in an electric circuits are

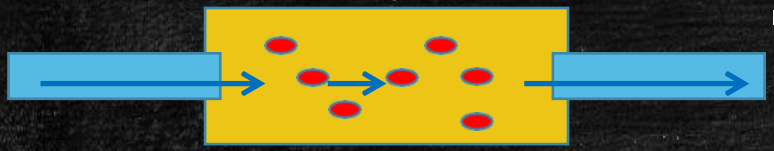
1. Resistance
2. Inductance
3. Capacitance

RESISTANCE

$R = 0\Omega$

- No more collision for electrons within the material
- Free flow of current (No drop)

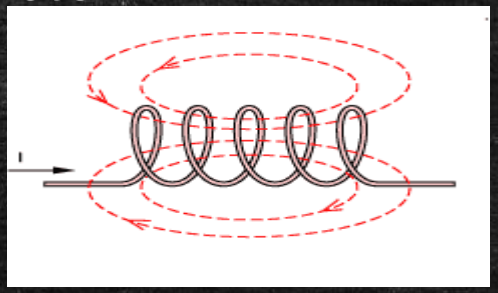
$R \neq 0\Omega$



- Due to physical property of material, collision of electrons with atoms of material takes place.
- The flow of current is resisted by value R
- Drop in potential across material

INDUCTANCE

- A wire of certain length is twisted into coil to form a basic inductor.



For larger 'I' more flux develops around coil

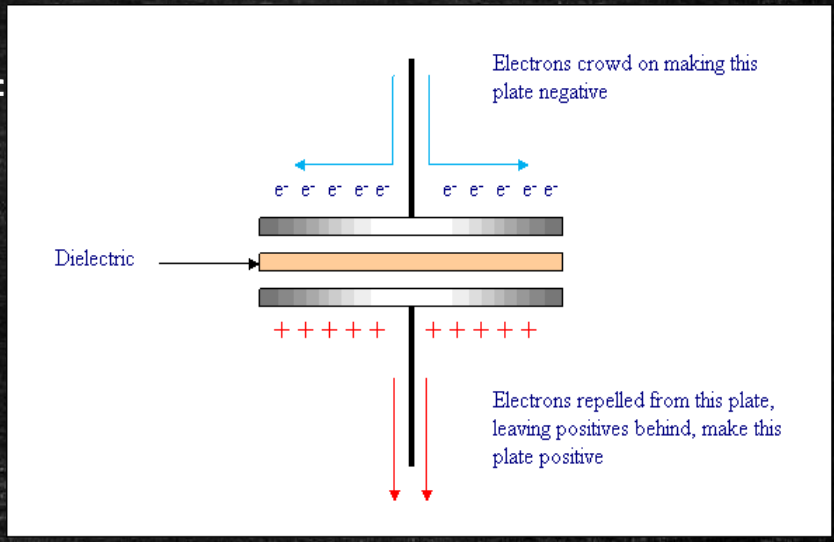
When 'I' changes instantaneously, flux also changes. According to faraday's law some voltage is induced, and it is given by

$$V = L\frac{di}{dt}$$

Note: For DC, $\frac{di}{dt}=0$. Hence V=0. (Short circuit)

CAPACITOR

- It has two conducting surfaces separated by dielectric.
- Capacitance is the amount of charge a capacitor can store when a voltage is applied across it.



$$C = \frac{Q}{V}$$

The simple presentation ends here

And finally, It's time to