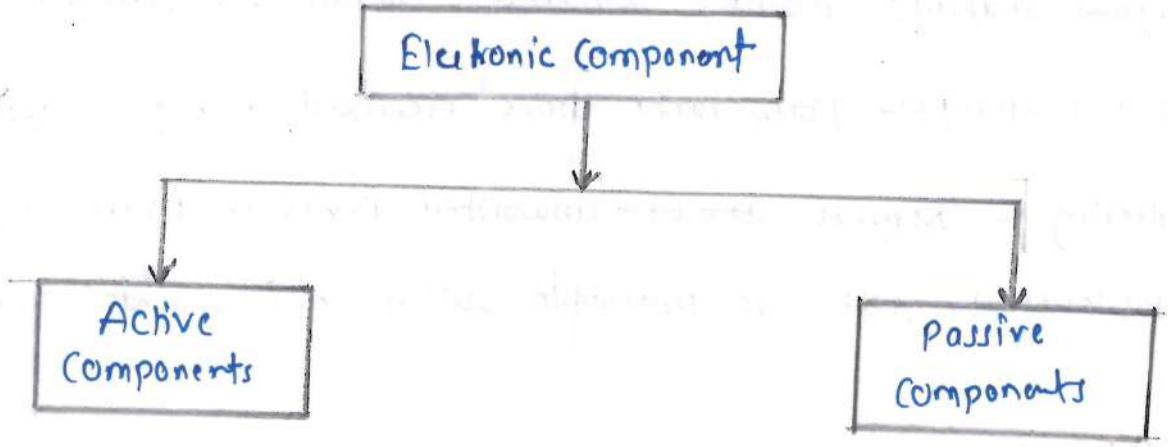


* Active Components :-

- Active electronic components can be defined as " devices that required external power source to operate.
- And they can amplify, switch, or otherwise manipulate electrical signal.

ex:- Transistor, Diode, LED, Photodiode, IC, op-amp, Seven Segment Display, Battery.

* ~~Passive Components :-~~

* Roles of active components.

- ~~Amplification~~:- Boost weak signals
- Switching :- Control the current flow
- Signal processing :- signal conditioning or manipulation.
- Power Regulation :- Convert or regulate voltage levels.

* Passive Components :-

- passive components are fundamental electronic devices that does not required external power source to operate
- A passive components that consume, store, or release electrical energy in circuit.

ex:- Resistor, LDR, Thermistor, capacitor, Inductor

* Roles of passive components.

- Signal shaping :- modify waveform characteristics (filtering)
- Energy storage :- Temporarily store electrical energy (capacitors, inductors)
- filtering :- Remove ~~unwant~~ unwanted frequencies from signals
- Stabilization :- helps to maintain voltage or current stability.

* ~~Difference~~

ex :- Resistor, LDR, Thermistor, Capacitor, Inductor, Transformer.

* Difference Between Active and passive Components :

Sr	Parameters	Active Components	Passive Components.
1)	power Requirements	Required external power to function	Does not required external power to function.
2)	function	Control, amplify, or generate electrical signals	store, dissipate, or release energy
3)	Signal Amp^n	can amplify electrical signals	Cannot amplify electrical signals
4)	Signal control	Can control, switch or modulate signal flow	Cannot control signal flow.
5)	Linearity	non linear in behavior	Generally linear in behavior
6)	energy Conversion	Can convert energy types	Do not Convert energy forms.
7)	Response to Signal	Actively manipulate or process signals	React passively to

* Active Components :- Do work :- they amplify, switch, processing signals using external power source.

* passive components :- React only :- They absorb, store, or resist electrical energy without adding energy.

* Resistor :-

- A Resistor is a passive electronic component that resist or limit (oppose) the flow of electric current in a circuit
- It follows Ohm's Law.

$$V = I \times R$$

where; V = Voltage across resistor (Volts)
I = Current through resistor (amp)
R = Resistance (ohm's Ω).

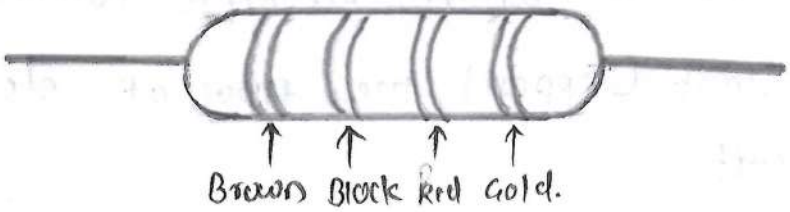
* Symbol :-

(Resistor Symbol)

* Colour Codes of Resistors :-

Colour	Digit	Multiplier	Tolerance
Black	0	10^0	–
Brown	1	10^1	±1%
Red	2	10^2	±2%
Orange	3	10^3	–
Yellow	4	10^4	–
Green	5	10^5	±0.5%
Blue	6	10^6	±0.25%
Violet	7	10^7	±0.1%
Gray	8	10^8	±0.05%
White	9	10^9	–
Gold			±5%
Silver			±10%

* Resistor colour code examples :-



1) Brown Black Red Gold
1 0 10^2 ±5%

$10 \times 10^2 = 1000$

∴ 1 kΩ

2) Red Violet Yellow Gold
2 7 10^4 ±5%

$27 \times 10^4 = 270000$

∴ 270 kΩ

3) Orange Orange Brown Gold
3 3 10^1 ±5%

$33 \times 10^1 = 330$.

330 Ω

4) Yellow Violet Orange Silver
4 7 10^3 ±10%

$47 \times 10^3 = 47000$

∴ 47 kΩ

5) Green Blue Red Gold
5 6 10^2 ±5%

$56 \times 10^2 = 5600$

∴ 5.6 kΩ

6) Blue Gray Brown Gold
6 8 10^1 ±5%

$68 \times 10^1 = 680$

680 Ω

7) Violet Green Orange Gold
7 5 10^3 ±5%

$75 \times 10^3 = 75000$

∴ 75 kΩ

8) Gray Red Red Gold
8 2 10^2

$82 \times 10^2 = 8200$

∴ 8.2 kΩ

9) White Brown Brown Silver
9 1 10^1 ±10%

$91 \times 10^1 = 910$

∴ 910 Ω

* Capacitor:-

- Capacitor is a passive two terminal electrical component that stores ~~ene~~ electrical energy in electric field.
- It temporarily holds the charge & relase when required.
- The amount of charge capacitor holds is called as capacitance (C) & measured in farads (F).

$$Q = C \times V$$

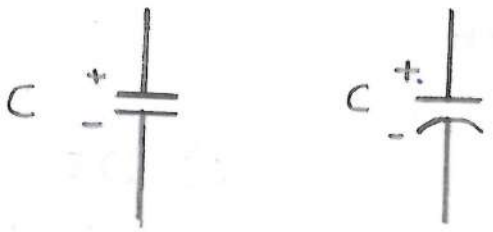
where;

Q = Charge (coulombs)

C = capacitance (farads)

V = voltage. (volts)

* Symbol:-



* Capacitor Codes Ceramic Disc Type.

Codes	Meaning.
104	10 followed by 4 zeros = 100000 pF = 100nF = 0.1μF
472	47 followed by 2 zeros = 4700 pF = 4.7nF.
102	10 followed by 2 zeros = 1000 pF = 1nf.
225	22 followed by 5 zeros = 2200000 = 2.2μF.

eg1) code 104

$10 \times 10^4 = 100000$ pf

$= 100$ nf.

$= 0.1$ µf.

2) 472 :

$47 \times 10^2 = 4700$ pf

$= 4.7$ nf.

3) code 102 =

$10 \times 10^2 = 1000$ pf

$= 1$ nf.

4) code 223

$22 \times 10^3 = 22000$ pf

$= 22$ nf

5) Code 331

$33 \times 10^1 = 330$ pf

6) code 103

$10 \times 10^3 = 10,000$ pf

$= 10$ nf

7) 684

$68 \times 10^4 = 680000$ pf

$= 680$ nf

$= 0.68$ µf

8) 105

$10 \times 10^5 = 1000000$ pf

$= 1$ µF.

* Applications:-

- Capacitor smooth out voltage fluctuation after rectification
- Capacitor determine timing interval.
- fan speed control:- helps in starting single phase motor.
- Camera flash:- Capacitor store charge & release quickly to power flash
- Blocks lower frequency.
- Used in tuning radios for adjustment of radio frequency.

*Inductor :-

- An inductor is a possive elecm'c components that stores energy in the form of magnetic field when elecm'c current flows tmyth it.
- It resist changes in current
- The property of inductor is called "Inductance" measured in henry (H)

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

where V = voltage across inductor

L = Inductance (H)

$\frac{dI}{dt}$ = Rate of change of current

* Symbol :-

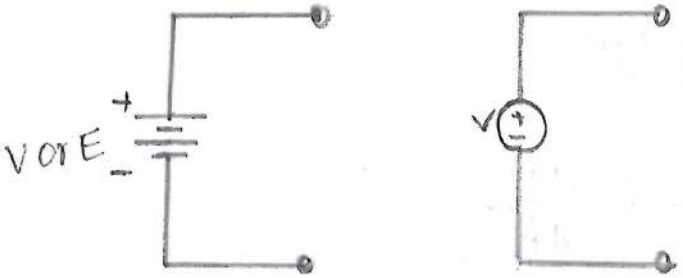
* Application :-

- Transformer :- Transfer elecmical energy between circuit via mutual Inductance
- Inductive proximity sensors to detect metal object ~~via~~ without contact
- Audio Crossover networks :- filters low freq: signals for woofers in speakers
- RF Tuning Circuits :- selects desire radio frequency using LC resonance.
- switch mode power supply: transfers energy efficiently in switchy regulators
- RF Tuning Circuits :-
- Chocks :- Blocks high frequency noise in power & signal lines

* Voltage source :-

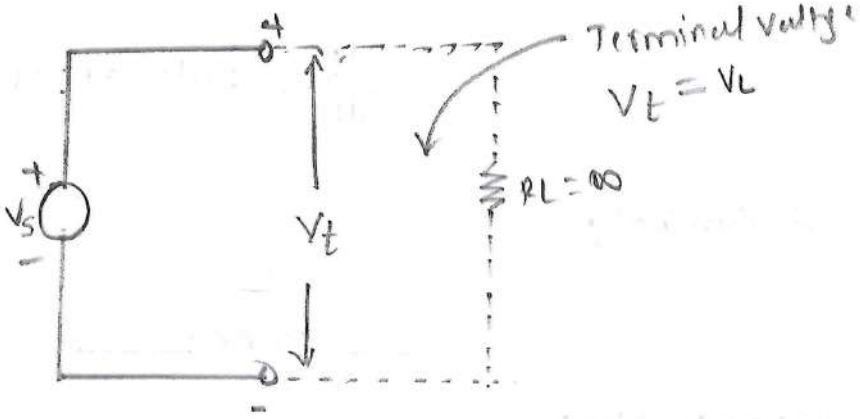
- An element of circuit that serves to create a potential difference between two points in a circuit is called as voltage source.
- an active circuit element that provides circuit with potential energy required to pass electrical current through it

* Ideal voltage source :-

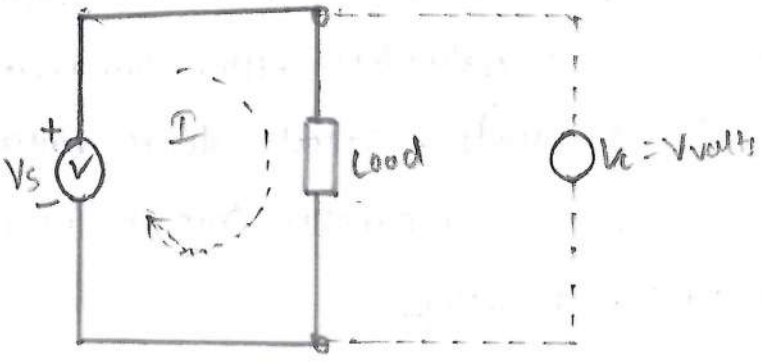


(Symbols)

* Terminal voltage without Load ($R_L = \infty$)

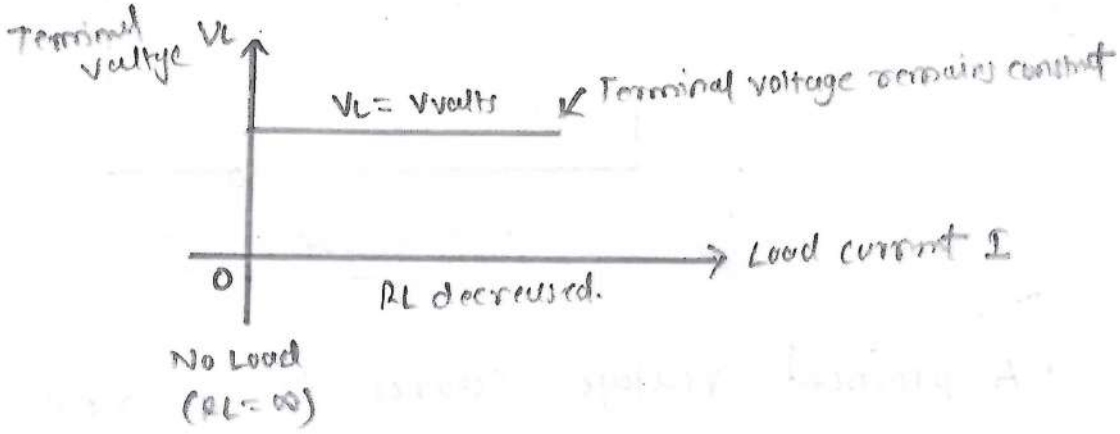


* Terminal voltage with Load (V_t = V volts)

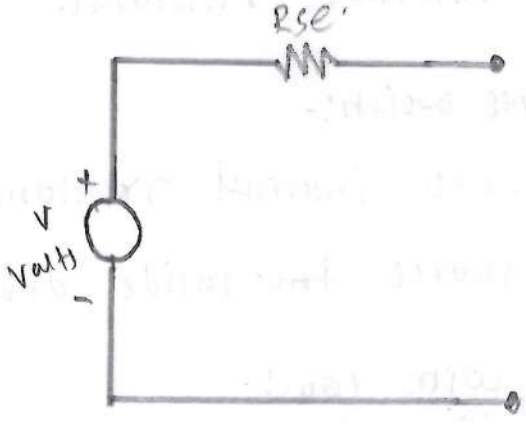


* Ideal voltage source :-

- An ideal voltage source can supply a constant voltage to circuit.
- It has no internal resistance (or impedance)
- There is zero internal resistance the voltage across its terminal is equivalent to the source voltage or emf.
- Because of ther is no voltage drop due to internal resistence. when the current is drown from an ideal voltage source.
- There is no power loss in it's internal circuit
- Means Terminal voltage remains constant.

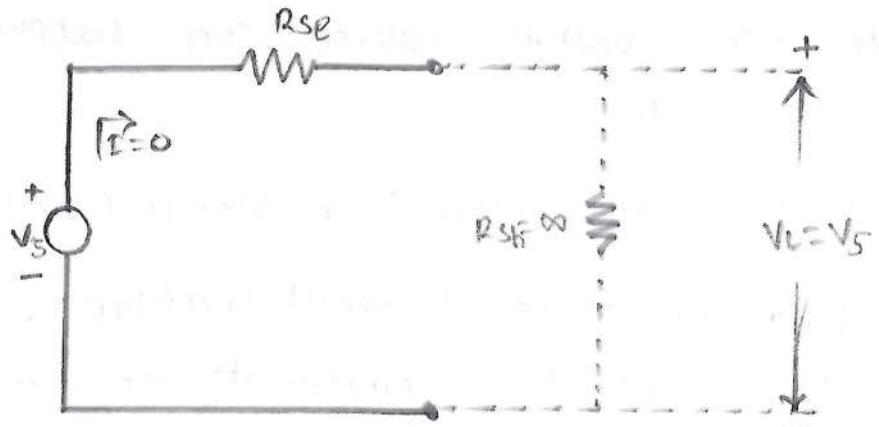


* Practical voltage source :-



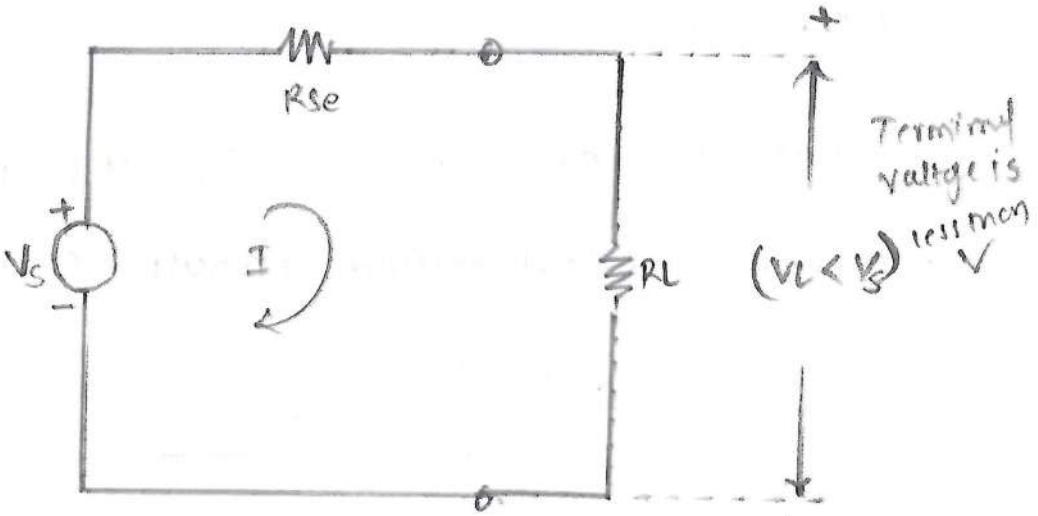
(Symbol)

*Terminal voltage at no load ($R_L = \infty$)



voltage at no load ($R_L = \infty$)

*Terminal voltage with load :- ($V_L < V$)



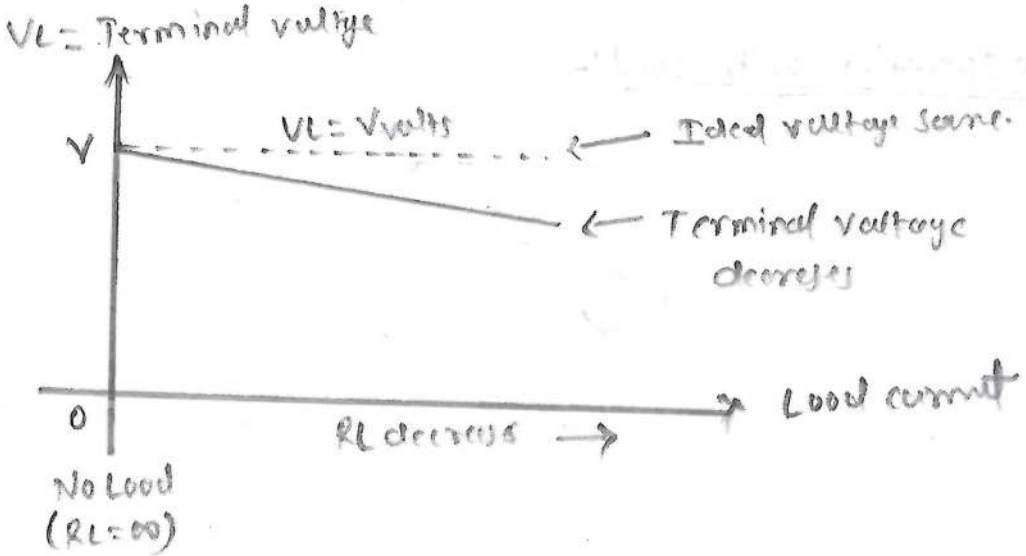
(Terminal voltage with load ($V_L < V$))

- A practical voltage source is a real world source like Battery or power supply that delivers voltage but include small internal resistance.
- Internal resistance exists :-
  It has non zero internal resistance in series with ideal voltage source ~~for~~ inside. device.
- voltage drops with load.
  when current is drawn, voltage across terminals

- Not constant output voltage.

Unlike ideal source the output voltage varies slightly depending on the load current.

- Some power loss takesplace inside the source as heat due to internal resistance.

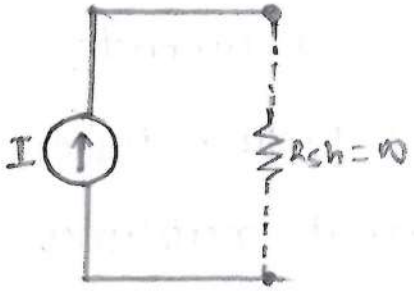


- There is variation of terminal voltage with change in load current

* Current Source:-

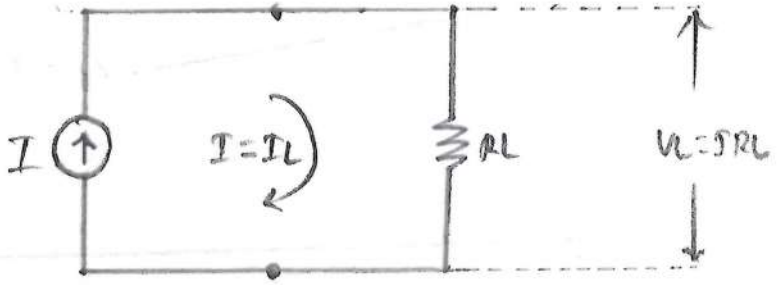
- A current source can be define as any device in a circuit which either delivers or absorbs the current in the circuit.
- The voltage across the current source is indipendent of voltage developed across it.
- It is necessary to maintain a constant current in that branch of the circuit even when the load is changed.

* Ideal current source symbol :-



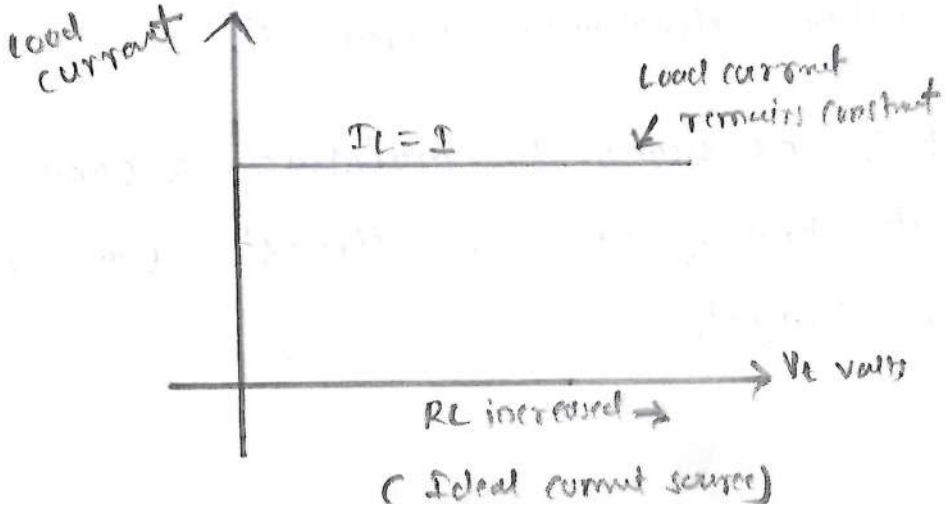
(Symbol)

* Operation with load :-



(operation with load connected)

- It is theoretical model in electrical circuit that supplies the constant current regardless of the voltage across it's terminals.
- It is characterised by having infinite internal resistance.
- all current have some finite internal resistance
- but ideal current provides a useful model for analyzing circuits

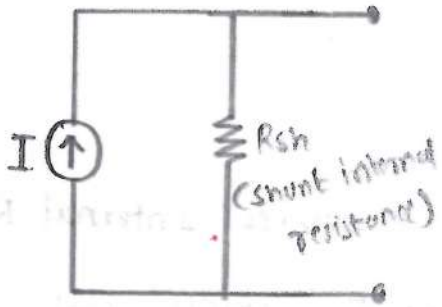


(Ideal current source)

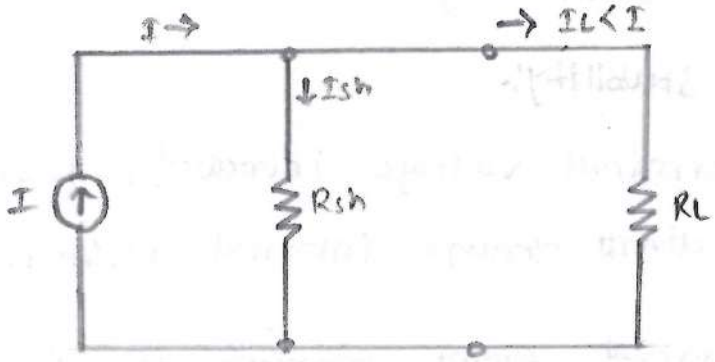
- Constant current :-
Current flowing thrugh the source remains constant

- Infinite Internal resistance :-
The source can maintain the current even at very high voltage

* Practical current source :-

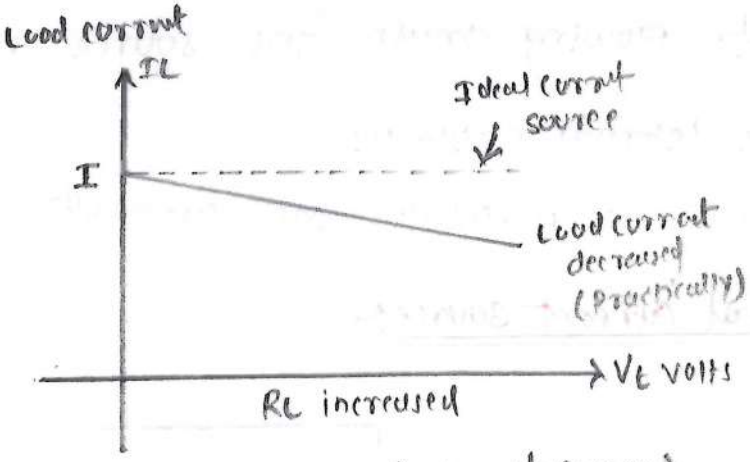


* operation with load connected.



- A practical current source is a real world current source
- It has finite internal resistance.
- means output current is not perfectly constant and varies with voltage across its terminals.
- It can be represented by an ~~not~~ ideal current source in parallel with high resistance or low conductance.

* Graph of variation of load current with change load.



(Practical current source)

- I practical current source Internal Resistance Exists.
- A practical current source has finite internal resistance
- It is moded with an ideal current source in parallel with high value resistor
- Current Stability:-

when terminal voltage increased, a small portion of a current diverts through internal resistor.

- Less current flows through the load & total output current slightly decreases.
- Terminal Behavior:-

with high load resistance terminal voltage increases → O/P currents drops slightly.

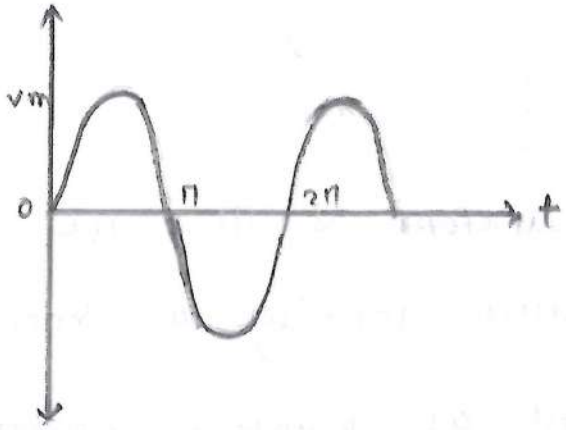
- With low load resistance :-

voltage is low → means more current flows through the load.

* Waveform:-

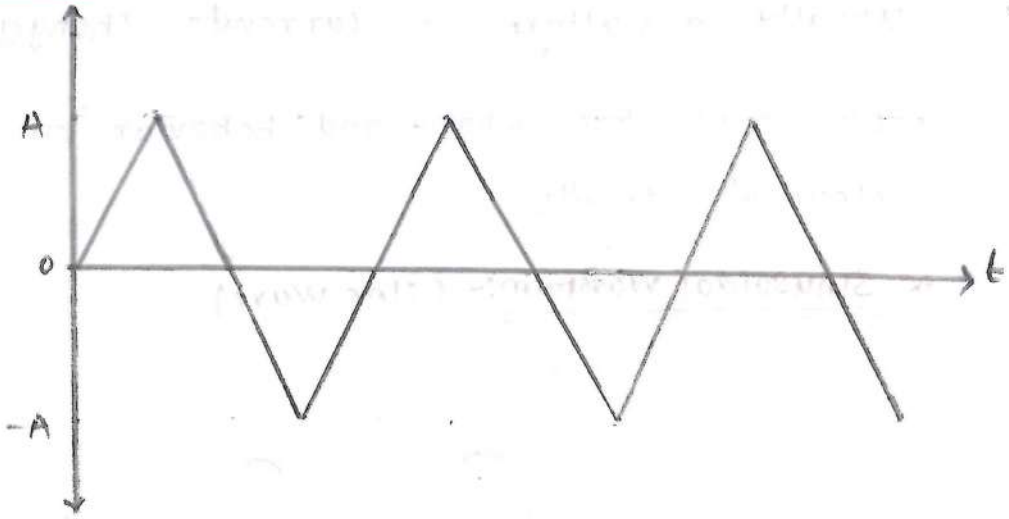
- Waveform is a graphical representation of how a quantity usually a voltage or current changes over time.
- It shows the shape and behavior of the signal in electrical circuits.

* Sinusoidal Waveform:- (sine wave)



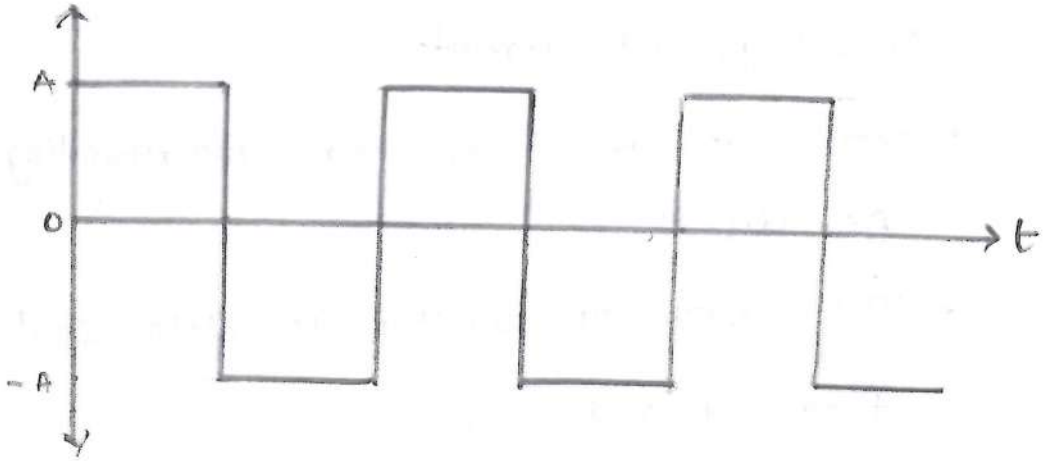
- A sinusoidal waveform is also known as sine wave
- It is smooth periodic waveform that oscillates up & down resembling the shape of sine function
- The sinusoidal waveform are ~~are~~ crucial for representing AC voltage and current
- They are foundation for understanding and analyzing AC circuits.
- The shape of waveform is determined by it's amplitude frequency and phase.
- They are basic building blocks for understanding more complex waveform phenomena.
- Audio waveforms are considered as pure Tones

* Triangular Waveform :-



- In triangular waveform as its name suggest, a linear rise & fall pattern forming a triangle like shape hence it called as triangular waveform.
- It is commonly used in signal processing, waveform generation and modulation.

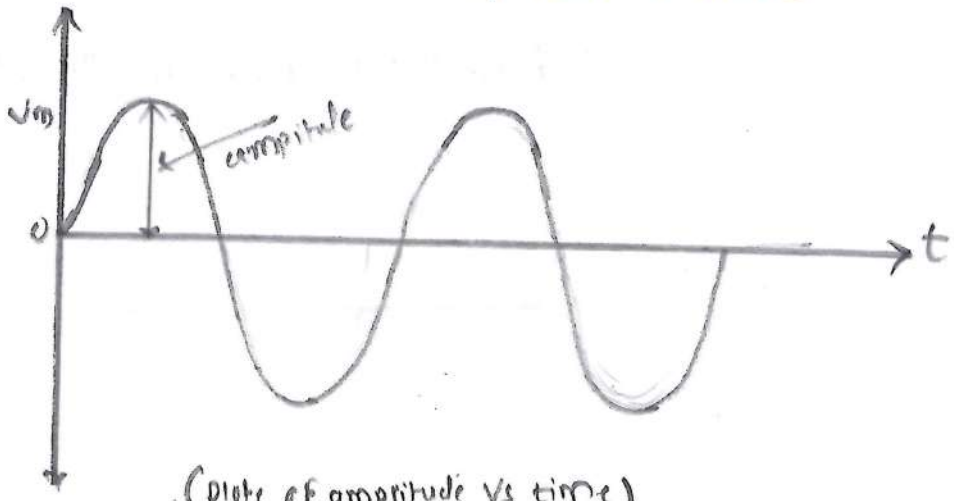
* Square Wave-form :-



- A square wave is a type of repeating signal that alternate between two distinct voltage levels
- ~~ofet~~ often refferred to as high & low with constant frequency.

*Time Domain Representation:-

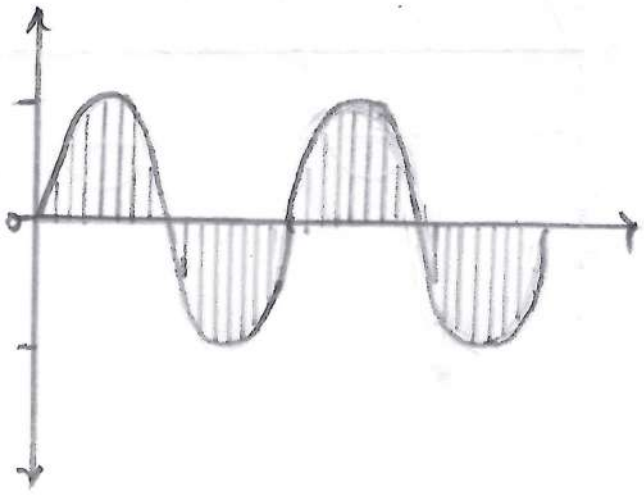
- Time Domain representation of a signal shows how the signals amplitude (value) changes with resp. to time.
- means signal is plotted as amplitude Vs time.



(plot of amplitude Vs time)

*Frequency Domain Representation:-

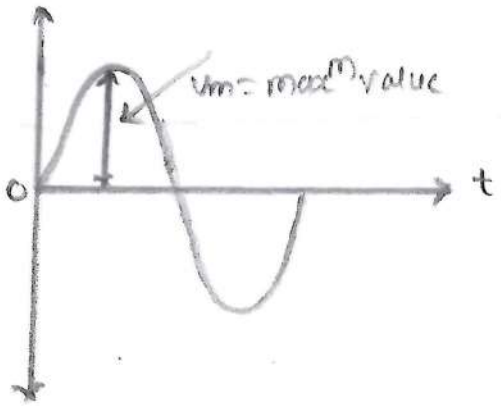
- Frequency Domain representation shows how much a signal lies within each frequency band over a range of frequencies.
- it is composition to show what frequencies are presents and how strong they are.
- means signal is ploted as amplitude vs frequney.



* Amplitued :-

- Amplitude con be define as a maximum value of +ve and -ve cycle of alternating quantity of AC signal.

∴ Amplitude Vm = maxm value.

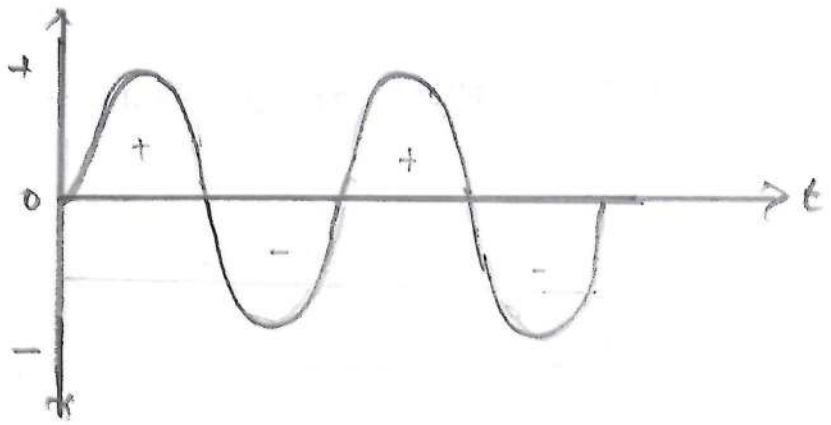


* frequency :-

- frequency con be defined as number of cycle per seconds in AC waveform
- measured in Hz (Hertz)

$$f = \frac{\text{cycle}}{\text{seconds}} = \frac{1}{\text{seconds/cycle}} = \frac{1}{T}$$

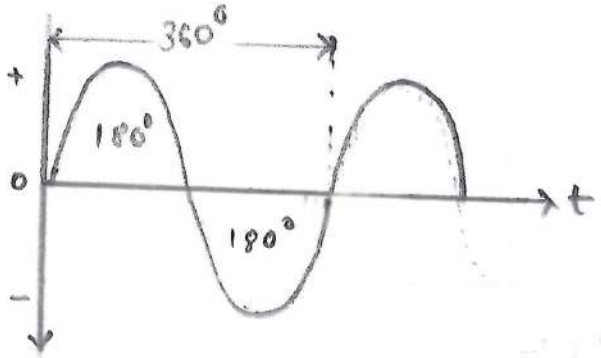
$$f = \frac{1}{T} \text{ in (Hz)}$$



* Phase:-

Phase in waveform can be define as position of wave at a point in time (instant) on a waveform cycle

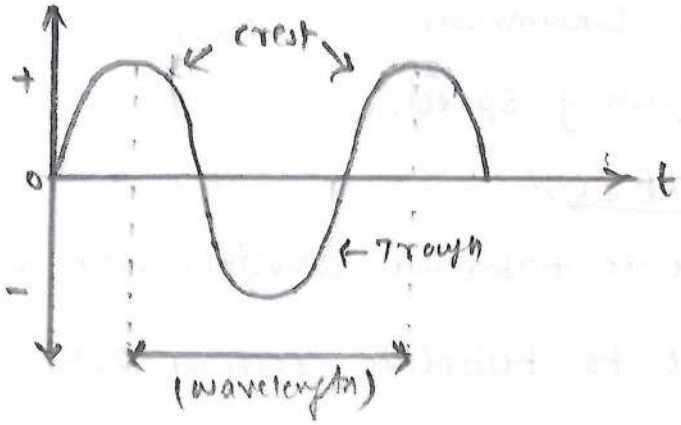
- a Complete wavecycle is 360° or 2π radians repreting full wave cycle.



* Wavelength:-

wavelength can be define as the distance between two identical points on a wave

- such as form crest to crest or trough to trugh.

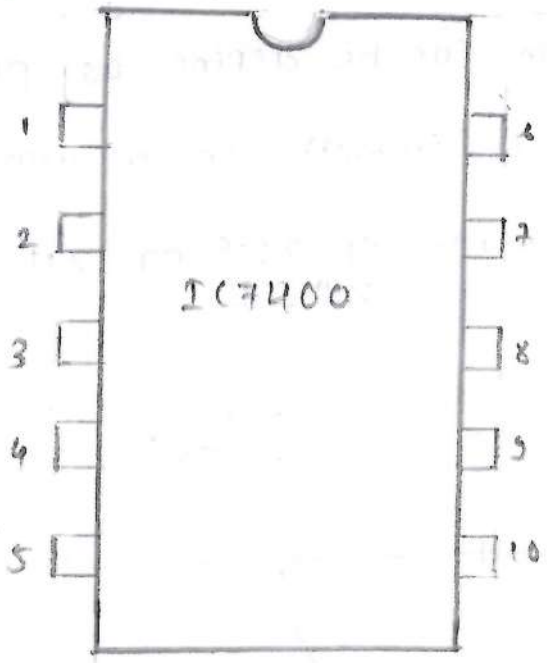


* Integrated Circuit :- (IC)

An integrated circuit is a compact electronic circuit built into a small semiconductor material (usully silicon) ~~Containing transistor,~~ &

- It performs functions like amplification, signal processing logic operations and memory storage all on a single tiny chip.

*IC (Pin diagram):



* Advantages of IC:-

- Small in size
- Low cost
- High reliability
- possible to fabricate in small circuits
- Low power consumption.
- Higher operating speed.

* Disadvantages of IC:-

- Not possible to fabricate capacitor over 30pf.
- Not possible to fabricate resistor over 100 kΩ
- Power dissipation for IC is limited.
- IC need extra care while handling
- They are complicate to manufacture.

* Applications of IC:-

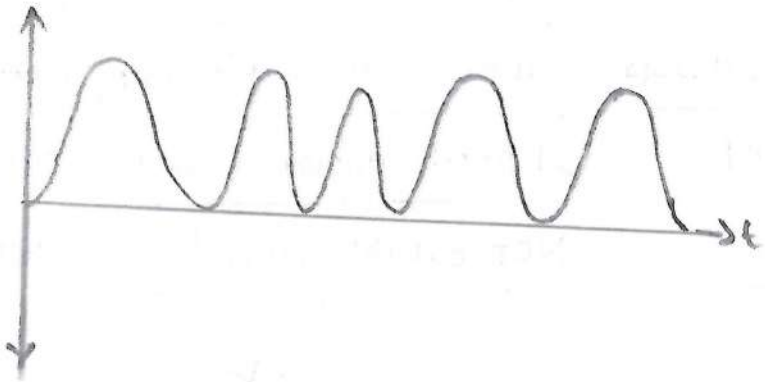
- Used in process control applications
- Used in many domestic appliances such as TV, washing machine, radios, AC, and in many more

* Analog Signals :-

- An analog signal is a continuos signal that con take ony value within given range
- It represent real world phenomena like sound, light, temprature, valtage.

eg:- Human voise (sound wave)

Temprature measured by thermometer.

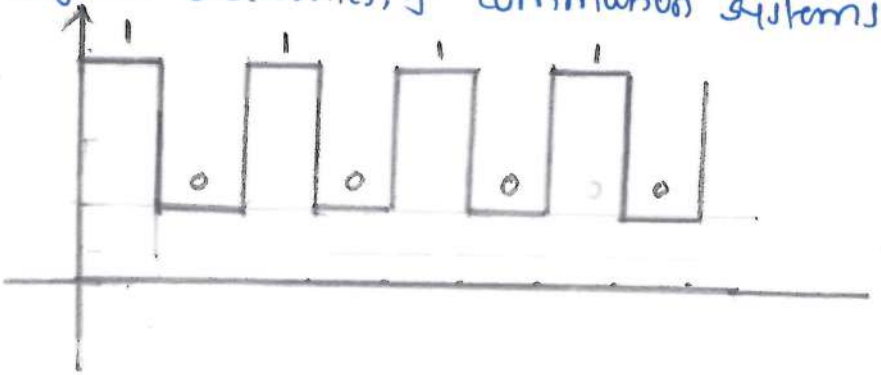


* Digital Signals :-

A Digital signal is a discrete time signal that takes on only a finite number of distint values tipically two levels.

1) High (1)
2) Low (0)

Digital signals represent data in binary form (0) and (1) used in Computers, Digital electronics, & Commution systems.



* Difference between Analog and Digital signal:-

Sr	Parameter	Analog Signal	Digital Signal.
1)	Signal Type	Analog signal is continuous type	Digital signal is discrete (stepwise) type.
2)	Value range	Analog have infinite vale range	Digital have limite vale range (0) and (1))
3)	Noise sensitivity	Analog signal have high	have low(immune to noise)
4)	Precision	High but hard to process	Limited but easy to handle
5)	Real world Data	Capture naturally in analog	need conversion (ADC /DAC)
6)	Processing	It needs analog circuits	processed by digital system.
7)	Storage	Not easily stored	easily stored in memory

18/6/25

Unit-3
BEE
18/6/25