# Network Theory

## Syllabus :-

Part 1
- (1.) Basic concept of Network.
- (2.) Two port Network
- (3.) Network Theorms

Part 2
- (4.) Transient Analysis
- (5.) Sinusoidal Steady State Analysis (SSSA)

A.C Analysis Part-3
- (6.) Phasor Diagram.
- (7.) Locus diagram
- (8.) Resonance
- (9.) Complex power.

- (10.) Graph Theory (Not in Gate)
- (11.) Network Synthesis (ESE)
- (12.) Filter Analysis [simple]

Module I.

# Basic Concept of Network.

→ Network & circuit

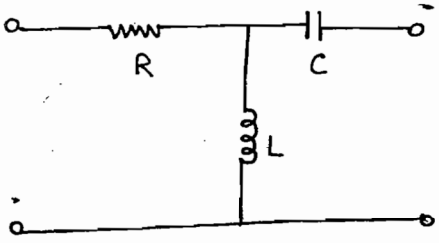



Fig. T N/w. Circuit ✗ NO

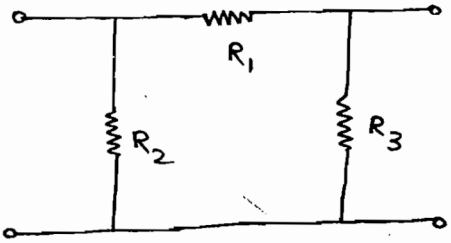



Fig π N/w circuit ✗ NO.

- IF any source connected in Network is called circuit.

Network + Source = circuit

- All circuit is Network but all Network is not circuit.

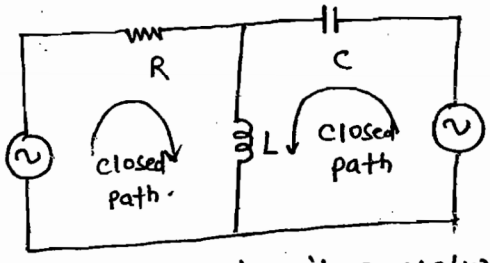



Fig. circuit & Network.

Circuit :-

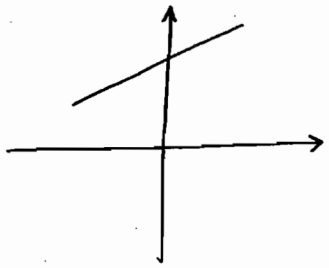
- An electric circuit is a closed energized Network.

circuit = Network + Source + Atleast one closed path.

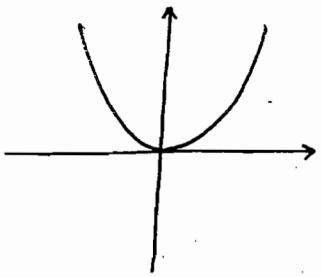
## 1.1 Types of Network element :-

### (1.) Linear and Non Linear Element :-

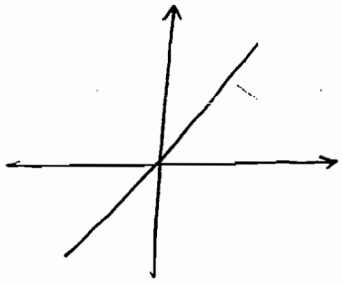
- Characteristics of Linear element always passes through the origin in the form of straight line.



Non Linear



Non - Linear



Linear

e.g of Linear element :-

- Network elements (R, L, C)

e.g. of Non Linear element :-

- Device Element (Diode, BJT, JFET, MOSFET)

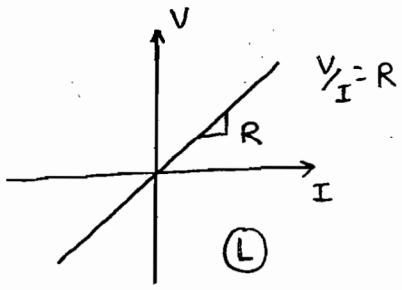
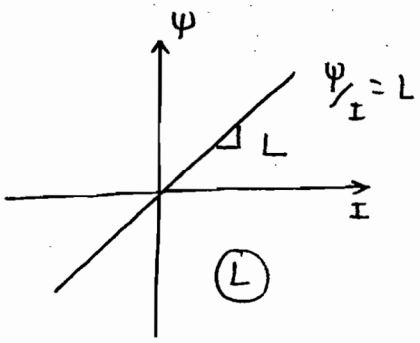
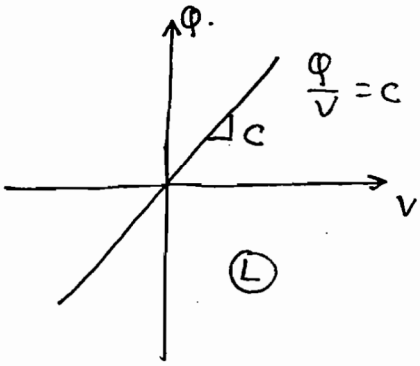


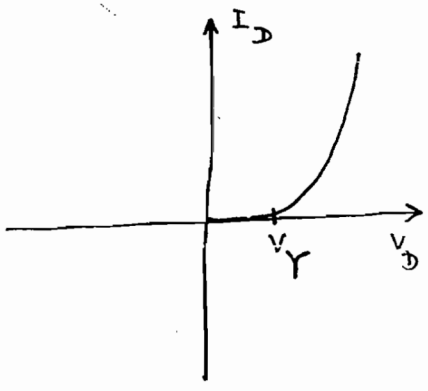

fig (a) VI plane



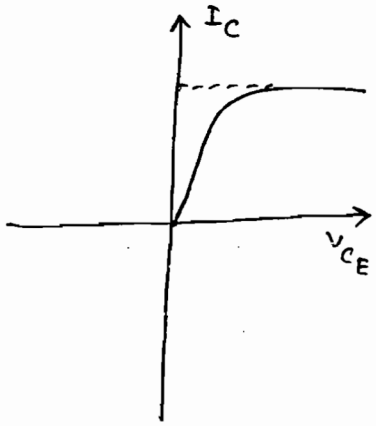

(b) ΨI Plane



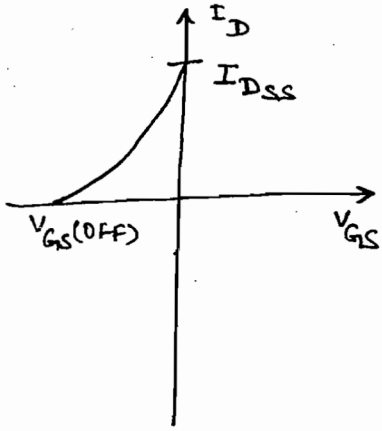

(c) qV Plane.




(a) Forward Bias C/S of diode




(b) O/P C/S of BJT

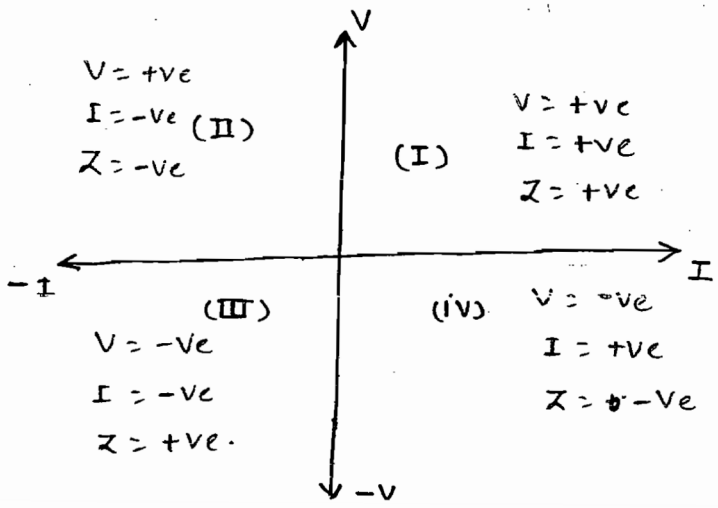


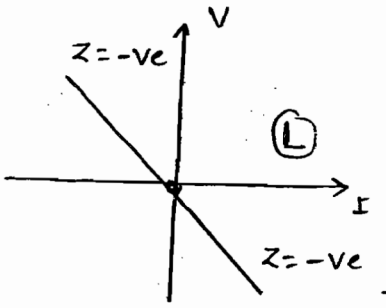

(c) Xfer C/S OF JFET

(2) Bilateral and unilateral Element

- In case of V-I Plane Characterstics of bilateral element offer Same Impedence through out the Characteristics.
- In case of V-I Plance characterstics of unilateral element offer different Impedence in different region.

*** In Case Generalized Plane or any Plane Charac. of bilateral element is always symmetrical about origin.




- odd Fn.

Fig (a) (B) - Symmetrical about origin

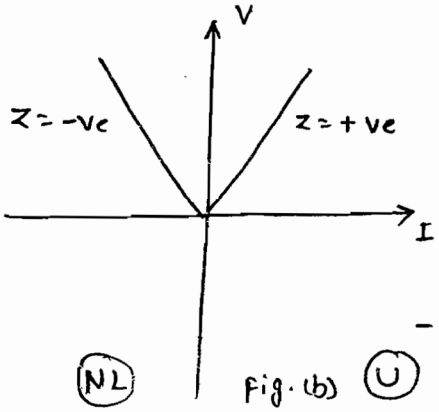



Fig. (b) (U) - Symmetric about Y-axis
- Even Funⁿ

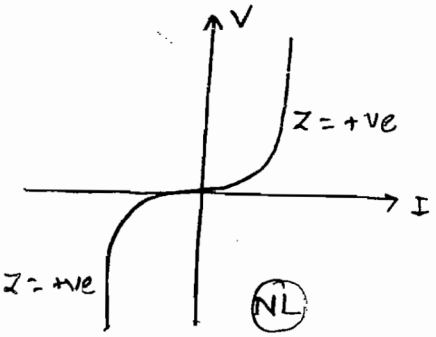



Fig. (C) (B) - Symmetrical about origin
- odd Fn.

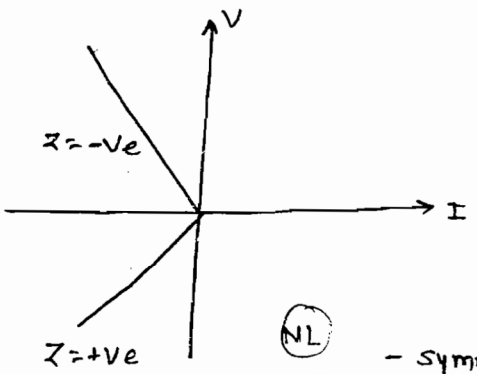



Fig (d) (U) - Symmetrical about x-axis.
- Neither odd Nor even.

| N/W element | B/U |
|---|---|
| R | B |
| L | B |
| C | B |

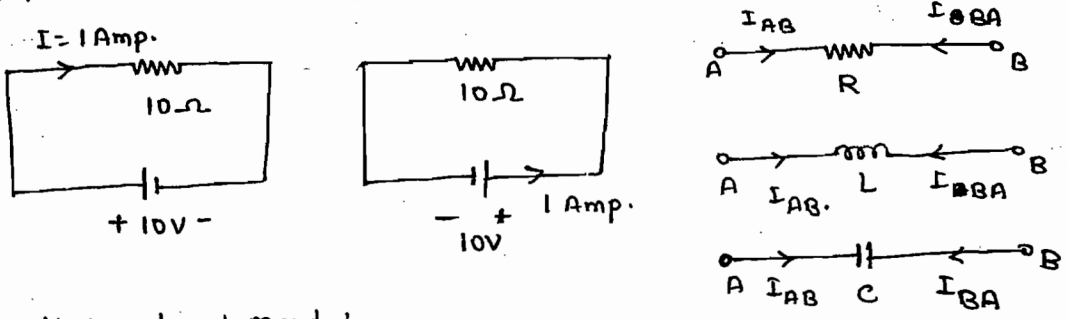
| Device element | B/U |
|---|---|
| Diode | U |
| BJT | U |
| MOSFET | U |

**

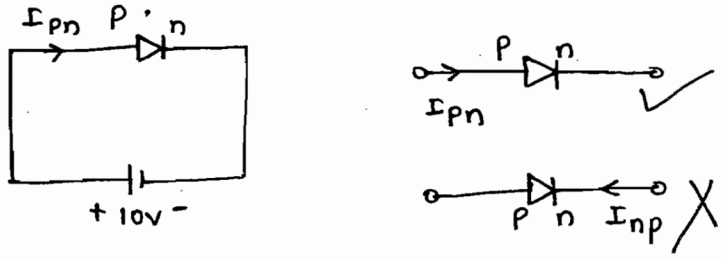
- In case of Bilateral element current will flow in both direction.

**- In case of Unilateral element current will flow in only one direction.

- Bilateral element :-




- Unilateral element :-




***

- All Linear element are Bilateral element but reverse is not True.

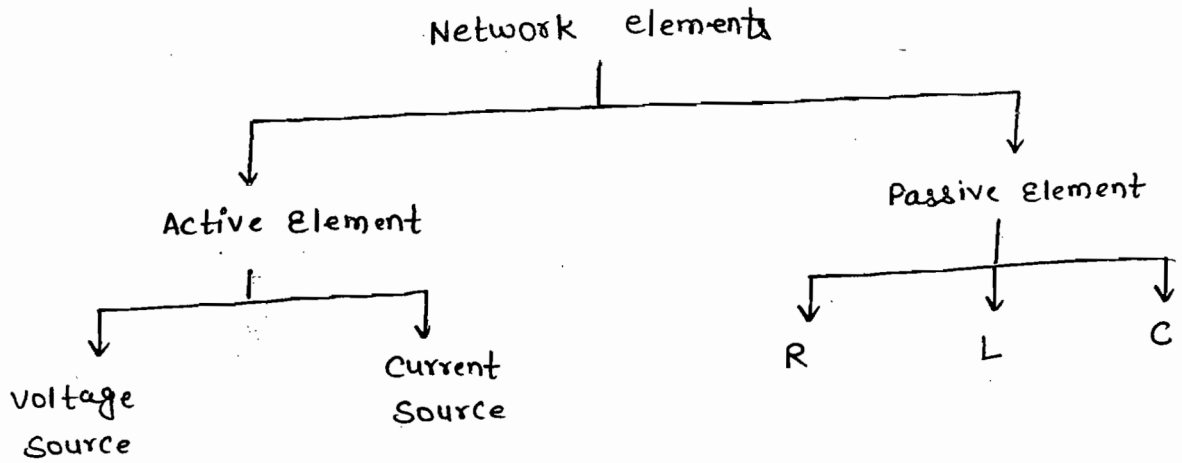
## (3.) Passive and Active Elements :-

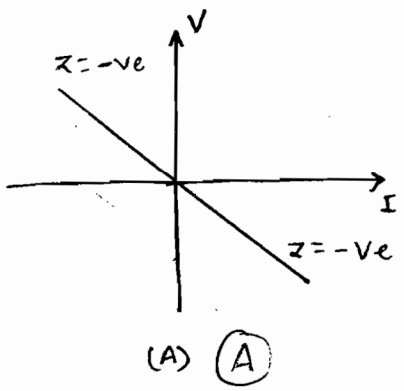
(i) In case of V-I plane characterstics of Passive Element always offer Positive Impedance. whereas Active Element always offer Negative Impedance.

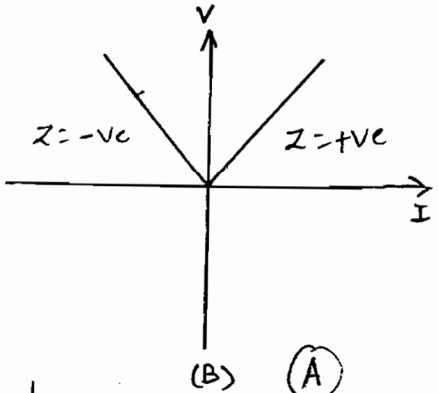
(ii) Passive Element always aborbs the energy whereas Active Element delivered energy.

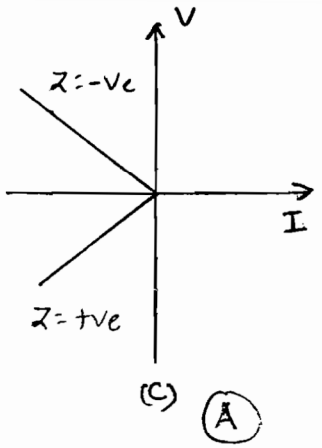
(iii) Active Element control the flow of Energy. whereas Passive Element dissipates or stored the energy.

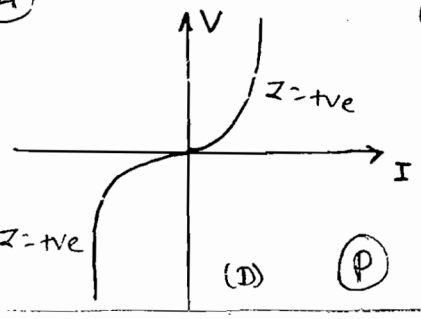
(iv) IF element have capability of delever the energy then it is reffered as Active Element.



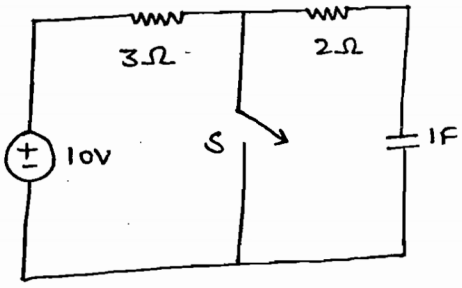



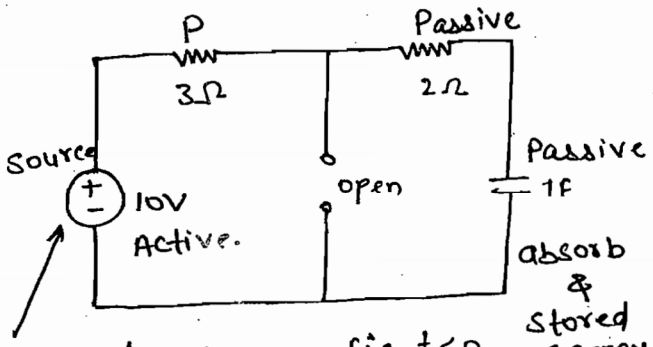
| N/w Element | Passive | Active |
|---|---|---|
| R | $R \geq 0$ | $R < 0$ |
| L | $L \geq 0$ | $L < 0$ |
| C | $C \geq 0$ | $C < 0$ |

**

- Globaly Inductor (L) and capacitor (C) are Passive Element but in case of transient during discharging Inductor and capacitor behaves as Active element.




Condition. At $t>0$, switch 'S' is closed.




Deliver/Supply Energy

Fig $t<0$

- source RC N/w
- charging N/w

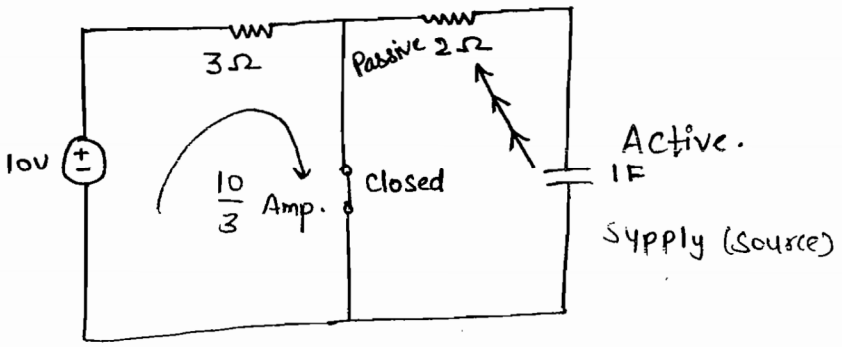



Fig. Source free RC N/w

or

Discharging N/w.

e.g. of Active Element :-

- Voltage Source
- Current Source
- Generator
- op- Amp.
- Biased Transistor.

- किसी terminal का Impedance Negative हो सकता है।

$Z = V/I$ Should be Negative also possible.

- The value is Not Negative of R, L, and C element.

(4.) Time Invarient and Time varient Element.

- Characteristics of TV element varries with time.

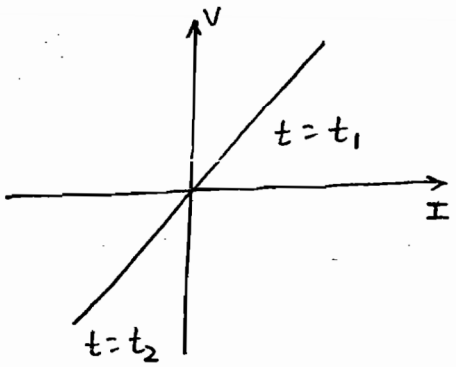



Fig. TIV

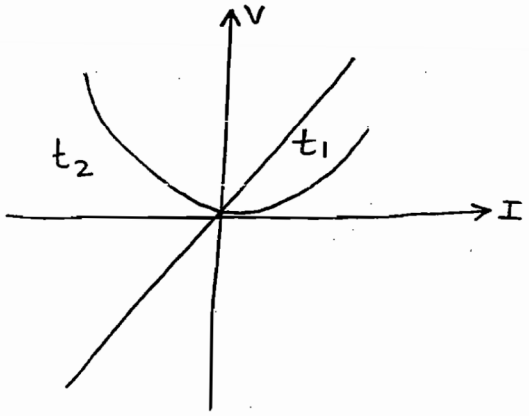
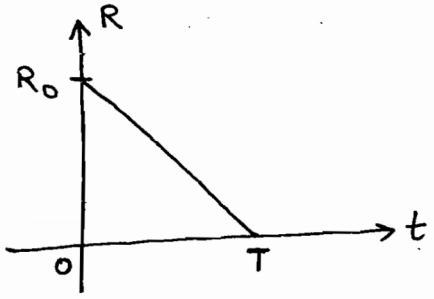



Fig TV

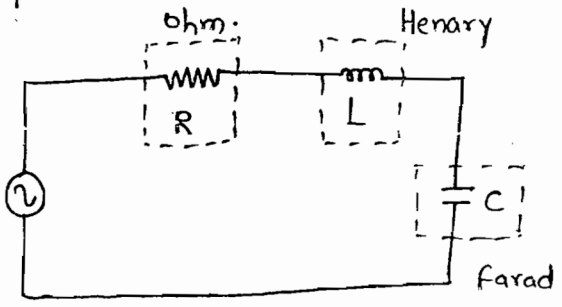
e.g :-

$R = R_0(1 - t/T)$




(5.) Lumped and Distributed Element.

- Physicaly Seperated Elements in the network is reffed as Lumped element.




- This N/W are physicaly Seperated.

- IF Element distributed along the Line or length then it is reffered as distributed Element.

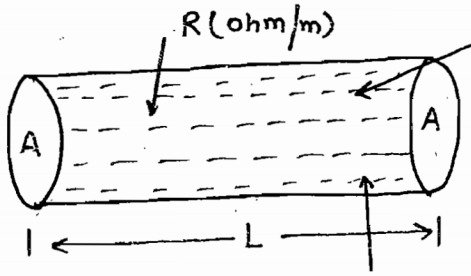



Fig. Transmission Line.

- In this fig. physically Speration is not possible.

** - Concept of Circuit Theory is based on Lumped Element

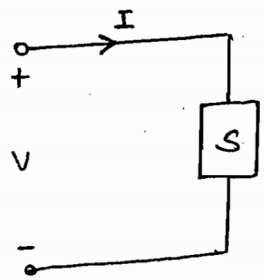
** - Concept of Field Theory is based on distributed Element (used in Power system)

Conclusion :-

properties of N/w Element (R, L, C) :-

- Linear
- Bilateral
- Passive
- Time Invarient
- Lumped Element.

Q.1 Consider the N/w shown in below fig.




The relationship b/w V and I across Element S is given by following fig. Identify the behavior of S.