Electrical Engineering

Electronics and Communication Engineering

NETWORK THEORY

Lecture No. 01

BASICS OF NETWORK THEORY

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1. Basics
2. $q(t)$, $i(t)$, $v(t)$
3. $P(t)$, $w(t)$
4. Power absorbing
5. Power Delivers
6.

Basics of Network theory

Charge $(q(t))$

current $(i(t))$

Voltage $(v(t))$

Power $(P(t))$ ⟷ Energy $(W(t)$ or $E(t))$

[Basic Building block of N/w theory]

charge. ($q(t)$) → It is a bipolar → ⊕, ⊖

- It is the most fundamental Quantity.
- charge exposure can be felt.

charge has two electrical effects.

Separation of charge
(Energy will be expended to create the force).
↓
Force → $v(t)$ → voltage

flow or Motion of charge.
↓
It creats electric fluid.
↓
current ($i(t)$).

$$v(t) = \frac{dW}{dq} \rightarrow \text{'volt'}$$

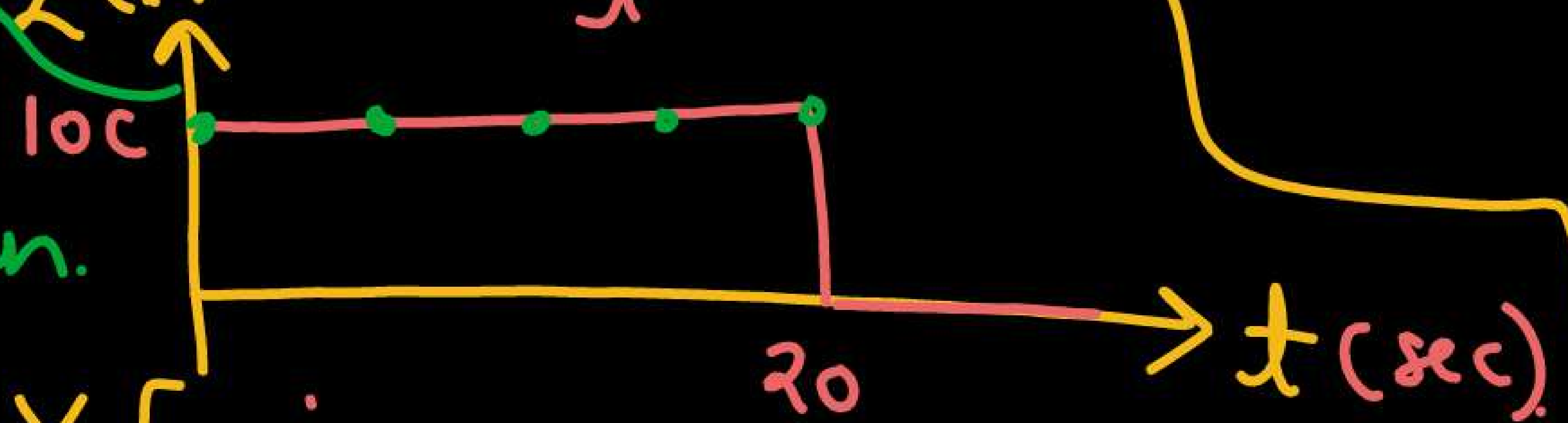
$\downarrow$ J/C

$$i(t) = \frac{dq}{dt} \rightarrow (\text{Ampere})$$

$\downarrow$ C/second.

or

$$i(t) = \text{'}\frac{q}{t}\text{'}$$



$$i(t) = \frac{d\,q(t)}{dt}$$

$$= \frac{d}{dt}(10)$$

$$= (0\ A) \checkmark$$

General expression. (Always applicable)

$$\times \left[i(t) = \frac{10}{20} = \frac{1}{2} = 0.5\ A \right]$$

{conditional expression & valid if we have constant current}

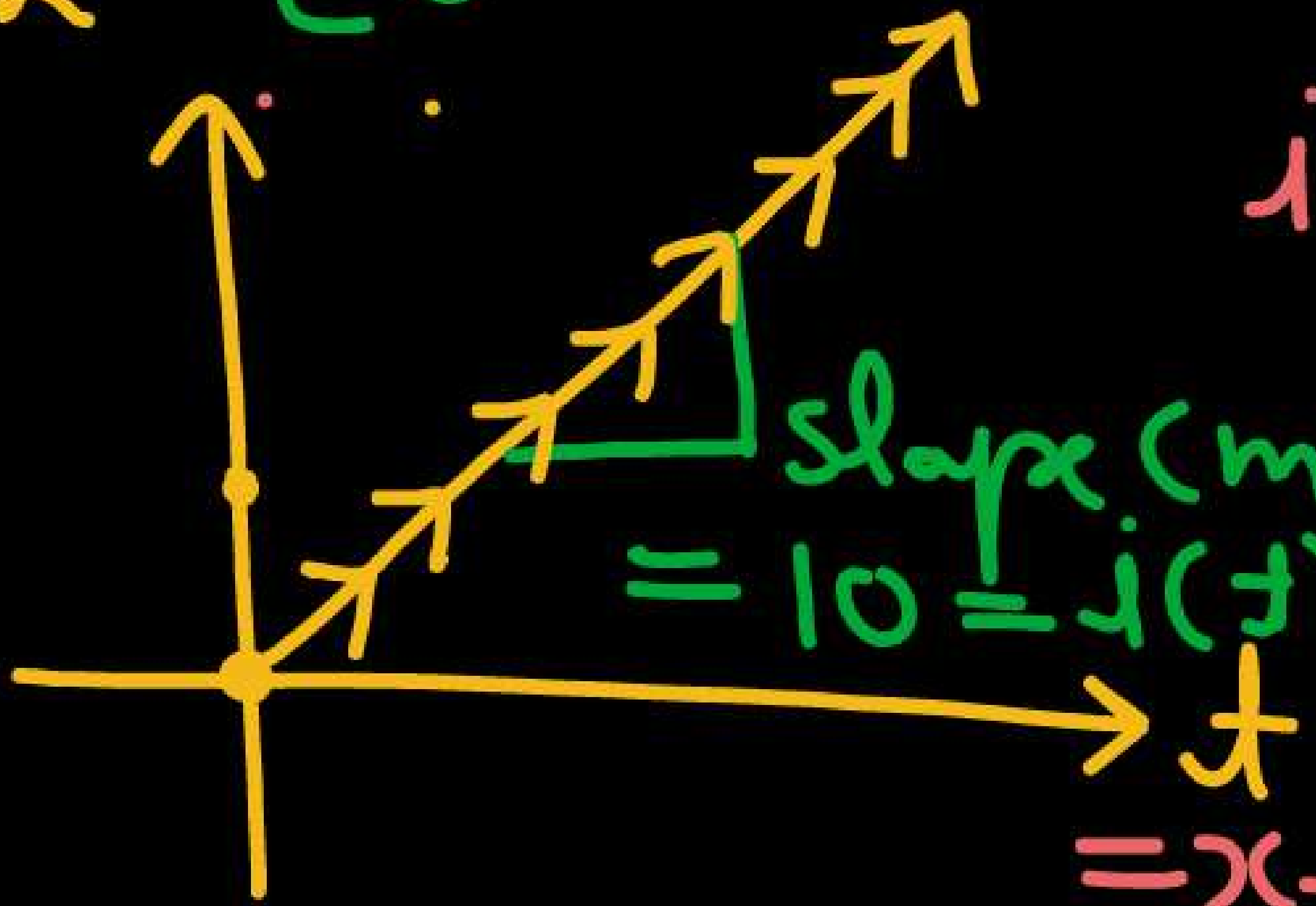
$[\; q \propto t \;]$

- $q(t) = 10\,t \rightarrow$ Ramp signal

$q(t) \rightarrow y$, $10 \rightarrow m$, $t \rightarrow x$

$i(t) = (10 \times 1)$

$= y\text{-axis} \; q(t) \; [\, y = mx \,]$



slope (m) $= 10 = i(t) =$ rate of change

$= x\text{-axis}$

$=$ Differentiation

$=$ Slope (m).

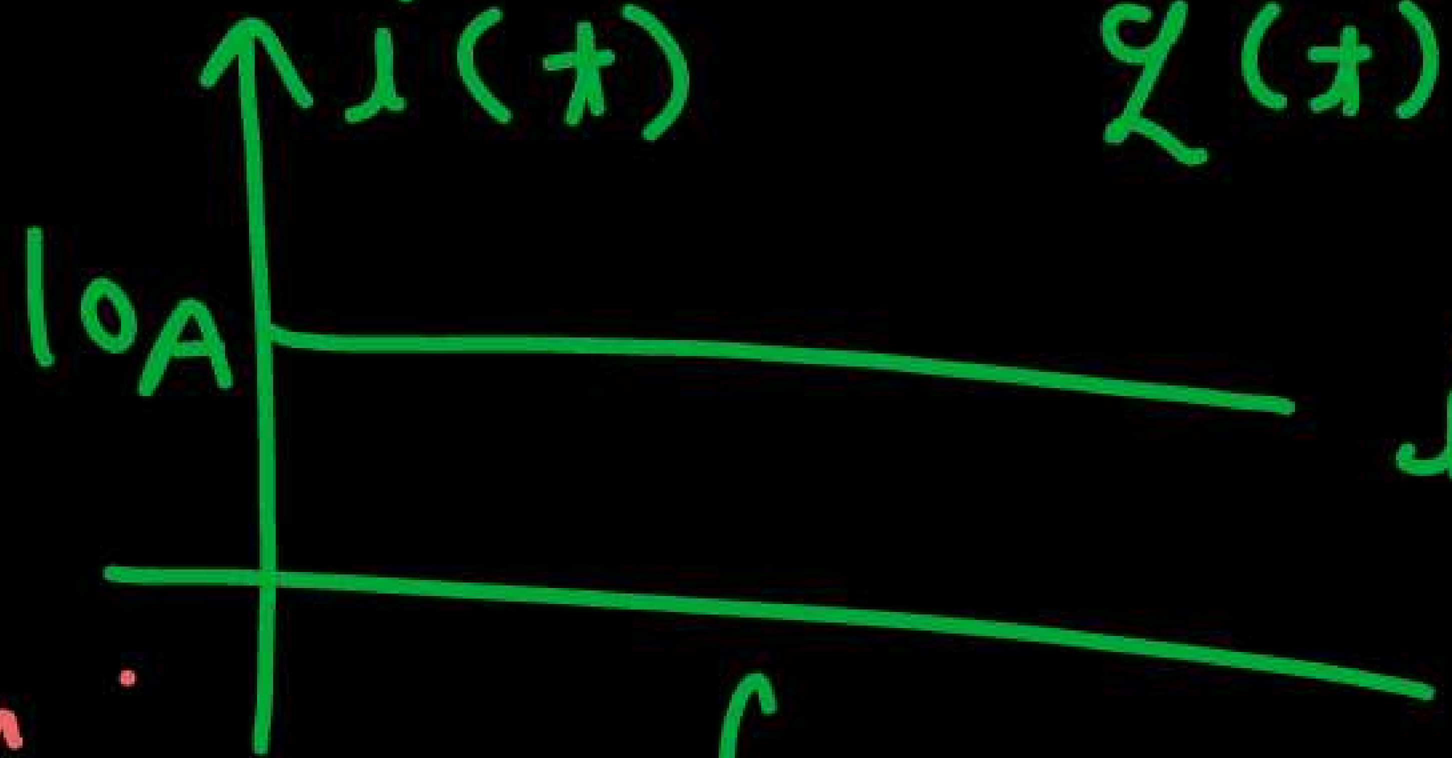
$i(t) = \dfrac{d}{dt}(10t)$

$i(t) = \dfrac{d}{dt}(q(t))$

$i(t) = \dfrac{dq(t)}{dt}$

$\int dq(t) = \int i(t)\cdot dt$

$$\boxed{q(t) = \int i(t)\cdot dt}$$



$q(t) = i(t) \times t$

$i(t) = \dfrac{q(t)}{(t)}$

$q(t) = \int 10\cdot dt = 10 \times t$

Note:

① $\frac{d}{dt}(f(t)) \longrightarrow$ Slope of f Vs t curve.

② $\int f(t)\,dt \longrightarrow$ Area of f Vs t curve

[• The relation b/w $v(t)$ & $i(t)$ can be co-related with Power & energy.]

$$P(t) = \text{Power} = \frac{dw(t)}{dt} \cdot \frac{dq}{dq}$$

$$P(t) = \left(\frac{dq}{dt}\right) \times \left(\frac{dw}{dq}\right)$$

$$\frac{dq}{dt} \rightarrow i(t) \qquad \frac{dw}{dq} \rightarrow v(t)$$

$$\boxed{P(t) = v(t) \cdot i(t)}$$

• $P(t) = \dfrac{dw(t)}{dt} \longrightarrow \int dw(t) = \int P(t)\, dt$

$$\boxed{w(t) = \int P(t) \cdot dt}$$

$$p(t) = \frac{dw(t)}{dt}$$ → Rate of change of energy wrt time.
→ Slope of $w(t)$ Vs 't' graph.

$$w(t) = \int p(t) \cdot dt$$ → Area under the curve
[$P(t)$ Vs 't']

Topic - 02: Concept of Absorbing & Delivering Power.

Network.

- It is a just connection of electrical elements.
- Minimum requirement of element to form a N/w is 2.

Circuit.

- It is also the connection of electrical elements but with certain fixed requirements.

① It must have atleast one Independent Source

② It must have atleast one closed path.

Note: "All circuits are always Network but all networks are not neccessarily to be a circuit"

Condition for the flow of current:

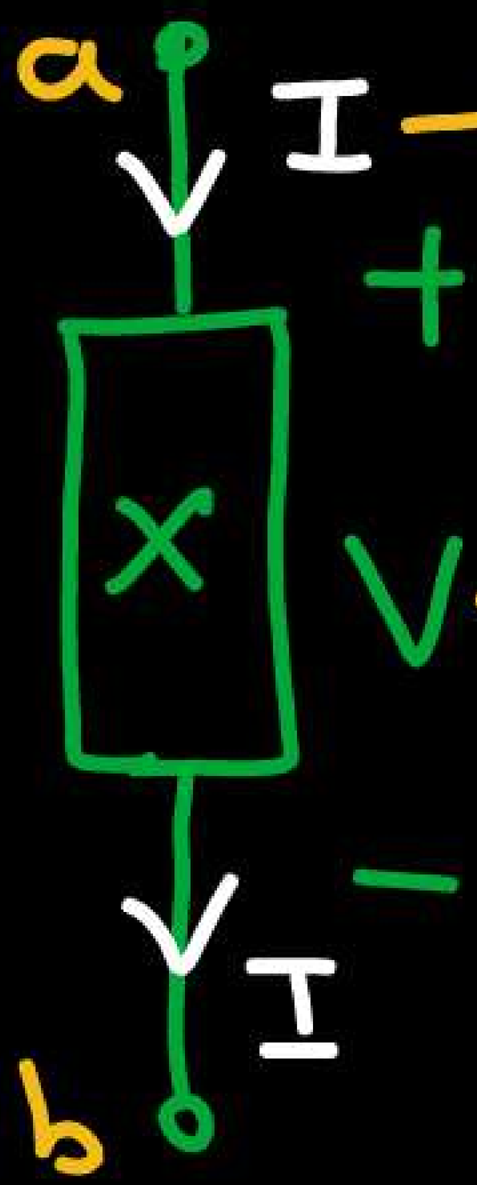
There are three-must condition:

Cod^{n} 01: There must be atleast one Independent Source in the N/w or circuit.

Condition 02: There must be atleast one closed Path.

Condition 03: There must be a return path also.

X & Y → can be Any element.



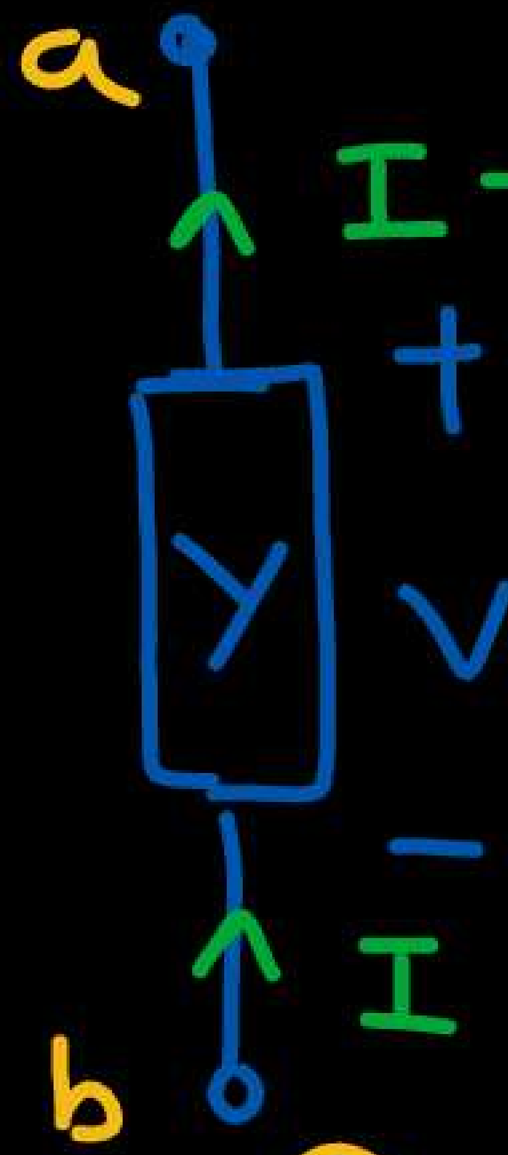
$I \rightarrow \oplus$ or $\ominus$

$V \rightarrow \oplus$ or $\ominus$

$P_x \rightarrow$ Absorbing Power

$P_x = (V \cdot I) \rightarrow \oplus$ or $\ominus$

It is Independent of the sign of V & I.



$I \rightarrow \oplus$ or $\ominus$

$V \rightarrow \oplus$ or $\ominus$

$P_y \rightarrow$ Delivering Power

$P_y = V \cdot I \rightarrow \oplus$ or $\ominus$

It is independent of sign of V & I.

- In a $\boxed{\text{whole}}$ electrical circuit :

(1) $$\left[\sum P_T \text{ or } \sum W_T = 0\right]$$

→ Energy or Power conservation Principle.

or

→ Energy can not be created or can not be destroyed.

(2) In a whole circuit,

$$\left[\sum P_{T}(\text{Actual Deliver}) = \sum P_{T}(\text{Actual absorb})\right]$$

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(telegram)

Thank you

GW Soldiers !