



The Shirpur Education Society's
R. C. Patel College of Engineering and Polytechnic, Shirpur
Department of Electrical Engineering

Notes

Unit - V

Network Theorems

NAME OF COURSE: - ELECTRICAL CIRCUITS AND NETWORK

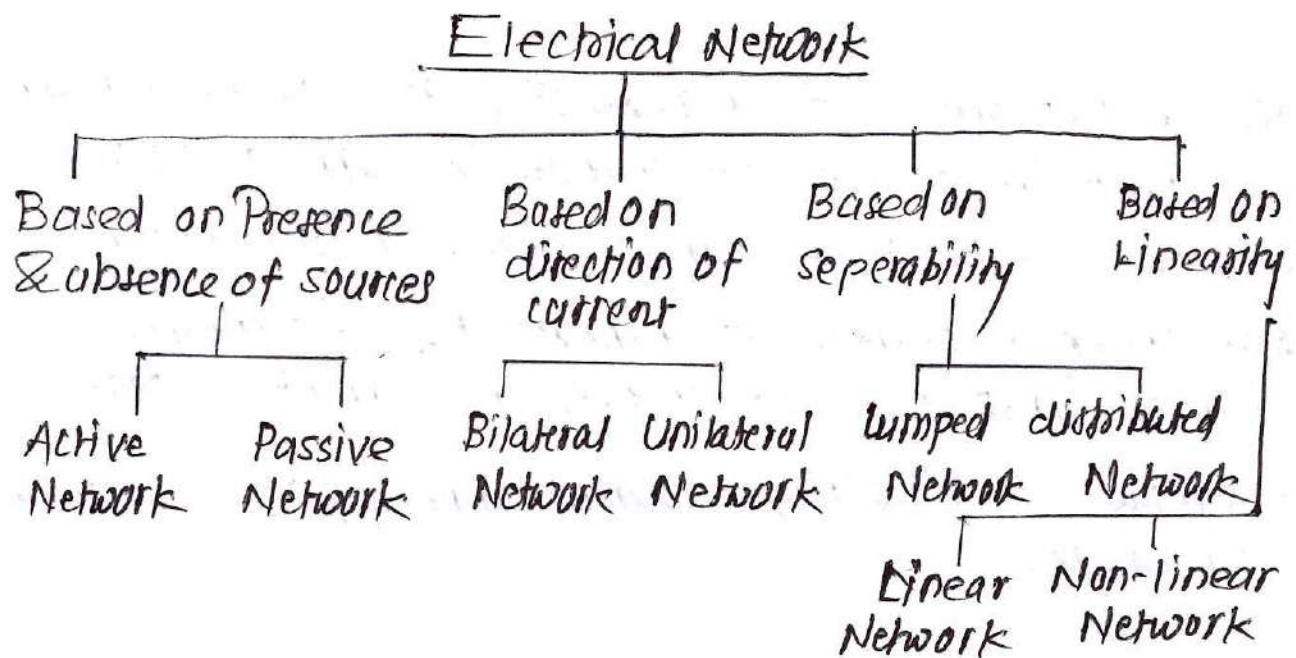
CODE OF COURSE: - 313332

SEMESTER: - SYEE-3K

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Unit 5: Network Theorems (18 Marks)

Prepared by: Mr. J.M. Suryawanshi Subject: ECN (313332)



Active Network If Network consist of an energy

source.

example: - Network consist of voltage source or current source

Passive Network: If Network does not contain any energy sources

example: - Network consist of R, L, C component.

Bilateral Network: Network whose characteristic does not depend on the direction of current

example: - Resistive Network

Unilateral Network: Network whose characteristics depend direction of current

example: - Network consist of diode & transistor.

Distributed Network If Network element are not physically seperable.

example: - Transmission line Network

Lumped Network: If Network element are physically seperable

example:- Simple electrical Network.

Linear Network:. If characteristics of Network remain constant irrespective of change in current, voltage.

example:- DC voltage source connected to resistors.

Non-linear Network:. If characteristics of Network changes irrespective of change in current, voltage.

example:- DC voltage source connected to semiconductor diode.

Superposition Theorem

Statement

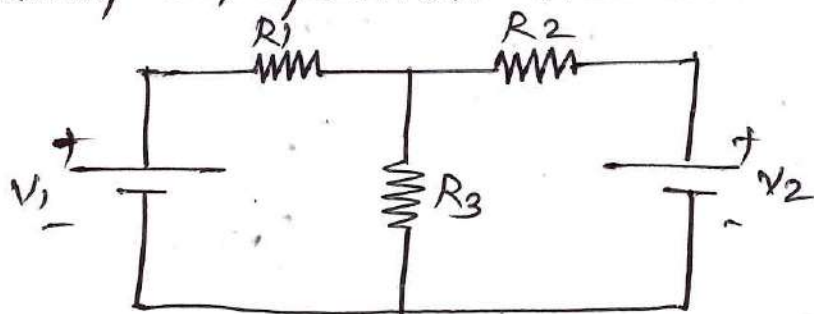
In any linear Network containing two or more sources, the response (current) in any element is equal to the algebraic sum of the response (current) caused by individual source - acting alone, while other are inoperative.
(Means. voltage source replaced by S.C & current source replaced by current source)

Steps:

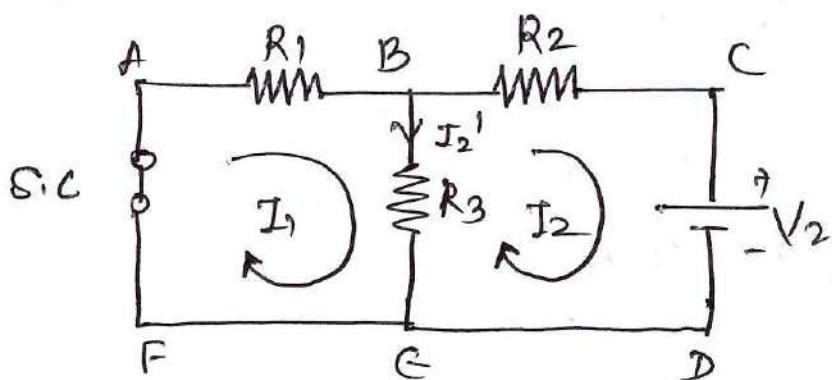
- ① Select any one energy source.
- ② Replace all other energy sources by their voltage sources replace by S.C
current source replace by O.C

- ③ With only one energy source calculate current flowing through branch.
- ④ Repeat step 1, 2, 3 for each source acting alone.
- ⑤ Take addition of ~~all~~ branches current due to individual sources.

example: Find the current flowing through R_3 by using superposition Theorem.



Step 1 \therefore Replace V_1 by s.c & find out current flowing through R_3 by using KVL



Apply KVL to Mesh AB EF-A.

$$-I_1 R_1 - R_3 (I_1 - I_2) = 0$$

$$-I_1 R_1 - I_1 R_3 + I_2 R_3 = 0$$

$$-I_1 (R_1 + R_3) + I_2 R_3 = 0 \quad \text{--- (1)}$$

Apply KVL to Mesh B(DE-B).

$$-I_2 R_2 - V_2 - R_3 (I_2 - I_1) = 0$$

$$-I_2 R_2 - V_2 - I_2 R_3 + I_1 R_3 = 0$$

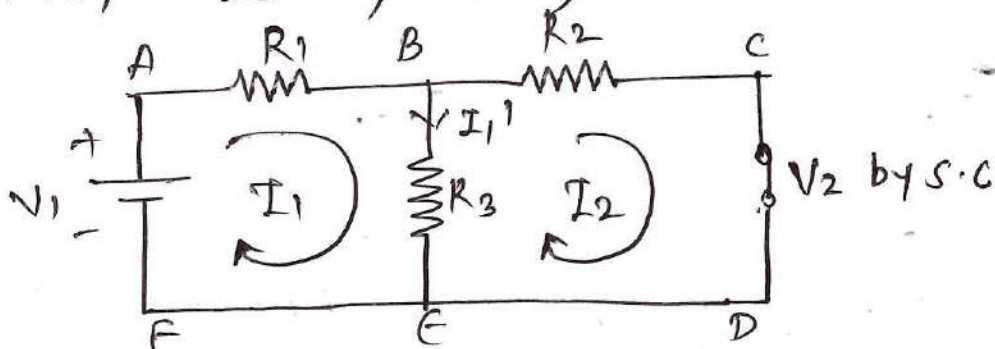
$$I_1 R_3 - I_2 (R_2 + R_3) = V_2 \quad \text{--- (2)}$$

Solve equation (1) & (2) simultaneously & find out the value of I_1 & I_2

Current flowing through R_3 is I_2'

$$I_2' = I_1 - I_2$$

Step 2: Consider V_1 source acting alone & V_2 replace by S.C. & find out current flowing through R_3 by using KVL



Apply KVL to Mesh ABFA

$$-I_1 R_1 - R_3 (I_1 - I_2) + V_1 = 0$$

$$-I_1 R_1 - I_1 R_3 + I_2 R_3 = -V_1$$

$$-I_1 (R_1 + R_3) + I_2 R_3 = -V_1 \quad \text{--- (1)}$$

Apply KVL to Mesh BCDE

$$-R_2 I_2 - R_3 (I_2 - I_1) = 0$$

$$-I_2 R_2 - I_2 R_3 + I_1 R_3 = 0$$

$$I_1 R_3 - I_2 (R_2 + R_3) = 0 \quad \text{--- (2)}$$

Solve equation (1) & (2) simultaneously & find out value of I_1 & I_2

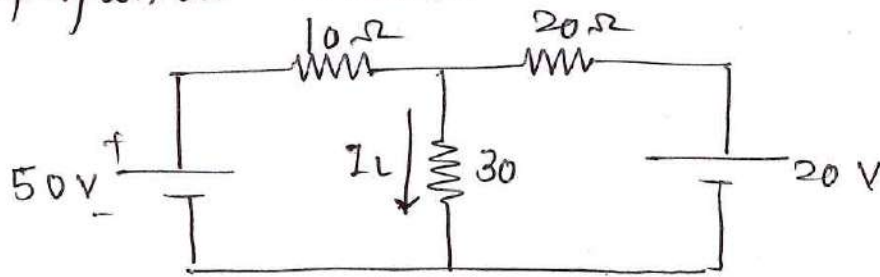
Current flowing through R_3 is I_1'

$$I_1' = I_1 - I_2$$

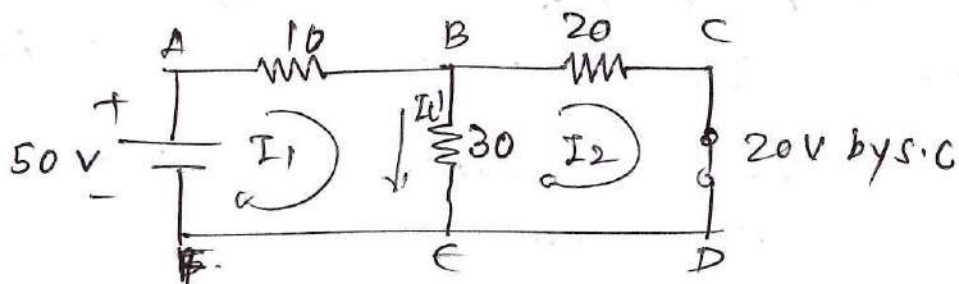
Step 3: Total current flowing through R_3 is

$$I_3 = I_1' + I_2'$$

Q. Find out current flowing through 30Ω by using Superposition Theorem



Step 1. Consider 50V source acting alone & 20V source replaced by S.C



Apply KVL to Mesh ABEF-A

$$\begin{aligned}
 -10I_1 - 30(I_1 - I_2) + 50 &= 0 \\
 -10I_1 - 30I_1 + 30I_2 &= -50 \\
 -40I_1 + 30I_2 &= -50 \quad \text{--- (1)}
 \end{aligned}$$

Apply KVL to Mesh BCDE-B

$$\begin{aligned}
 -20I_2 - 30(I_2 - I_1) &= 0 \\
 -20I_2 - 30I_2 + 30I_1 &= 0 \\
 30I_1 - 50I_2 &= 0 \quad \text{--- (2)}
 \end{aligned}$$

Solve equation (1) & (2) simultaneously

$$\begin{aligned}
 -40I_1 + 30I_2 &= -50 \quad \text{--- (1)} \times 5 \\
 30I_1 - 50I_2 &= 0 \quad \text{--- (2)} \times 3
 \end{aligned}$$

$$\begin{aligned}
 -200I_1 + 150I_2 &= -250 \quad \text{--- (1)} \\
 + 90I_1 - 150I_2 &= 0 \quad \text{--- (2)}
 \end{aligned}$$

$$-110I_1 + 0 = -250$$

$$\swarrow 110I_1 = +250$$

$$I_1 = \frac{250}{110} = 2.272 \text{ A}$$

Put value of I_1 in equation (1)

$$-40(2.272) + 30I_2 = -50$$

$$-90.88 + 30I_2 = -50$$

$$30I_2 = -50 + 90.88$$

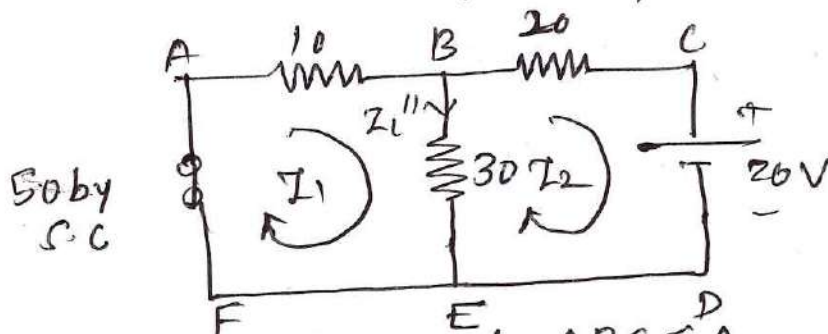
$$30I_2 = 40.88$$

$$I_2 = \frac{40.88}{30} = 1.3626 \text{ A}$$

Current flowing through 30Ω is $I_{L'}$ is

$$I_{L'} = I_1 - I_2 = 2.272 - 1.362 = 0.91 \text{ Amp}$$

Step 2: Consider 20V source acting alone & 50V source replace by S.C



Apply KVL to Mesh ABEFA

$$-10I_1 - 30(I_1 - I_2) = 0$$

$$-10I_1 - 30I_1 + 30I_2 = 0$$

$$-40I_1 + 30I_2 = 0 \quad \text{--- (1)}$$

Apply KVL to Mesh BCDE-B

$$-20I_2 - 20 - 30(I_2 - I_1) = 0$$

$$-20I_2 - 20 - 30I_2 + 30I_1 = 0$$

$$30I_1 - 50I_2 = 20 \quad \text{--- (2)}$$

Solve equation (1) & (2) simultaneously

$$-40I_1 + 30I_2 = 0 \quad \text{--- (1)} \times 30$$

$$30I_1 - 50I_2 = 20 \quad \text{--- (2)} \times 40$$

$$-120I_1 + 900I_2 = 0 \quad \text{--- (1)}$$

$$120I_1 - 200I_2 = 800 \quad \text{--- (2)}$$

$$-110I_2 = 800$$

$$I_2 = \frac{-800}{110} = -0.727 \text{ Amp}$$

put value of I_2 in eqⁿ (1)

$$-40I_1 + 80(-0.727) = 0$$

$$-40I_1 + 21.818 = 0$$

$$-40I_1 = 21.818$$

$$I_1 = -0.545 \text{ Amp}$$

current flowing through $30\text{-}\Omega$ is I_L''

$$I_L'' = I_1 - I_3 = -0.545 - (-0.727)$$

$$= -0.545 + 0.727$$

$$= 0.182 \text{ Amp}$$

Step 3: The total current flowing through $30\text{-}\Omega$ resistance is

$$I_L = I_L' + I_L'' = 0.91 + 0.182$$

$$I_L = 1.092 \text{ (A)} \text{ (clockwise)}$$

Thevenin's Theorem

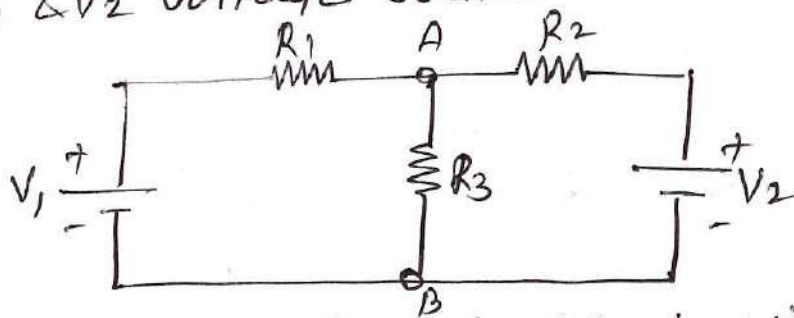
Statement - Any Network containing Active or passive element & one or more dependent or independent voltage or current source can be replace by an equivalent Network containing a voltage source (V_{TH} or V_{OC}) & series resistance (R_{TH} or R_{se}).

Steps:

- ① Remove branch, that current through which is to be obtained
- ② calculate open circuit voltage V_{OC} or V_{TH} (which is measure across the remove branch)
- ③ Obtain R_{TH} between open circuit points.
- ④ Draw Thevenin's equivalent circuit & connect the remove branch as load to find branch current.

Example:-

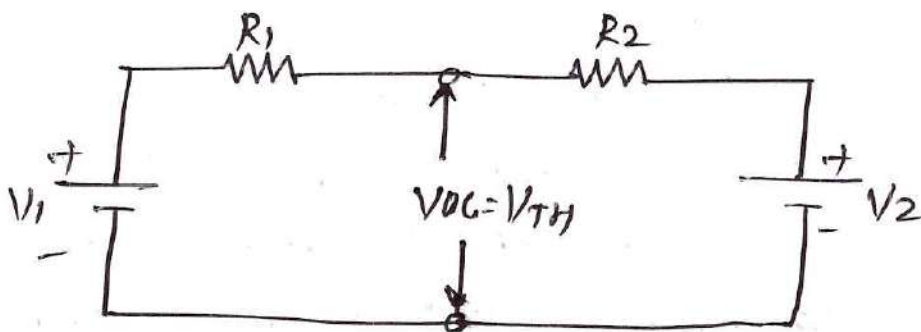
Consider a Network contains R_1 , R_2 , R_3 resistances & V_1 & V_2 voltage sources.



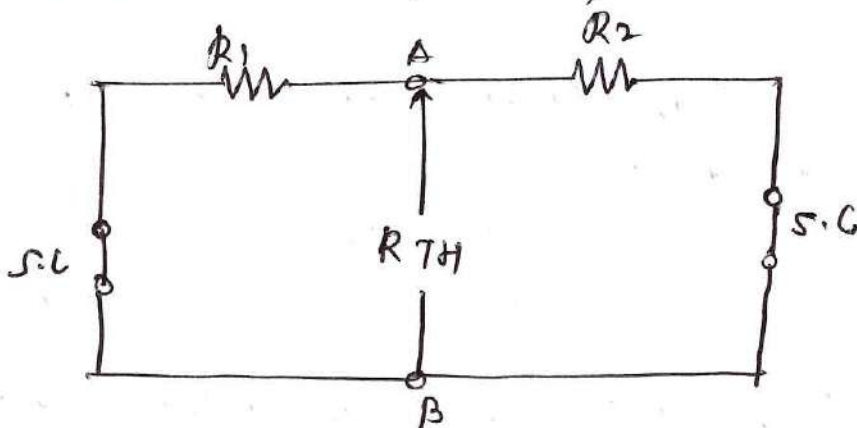
Find current through AB by using thevenin's theorem

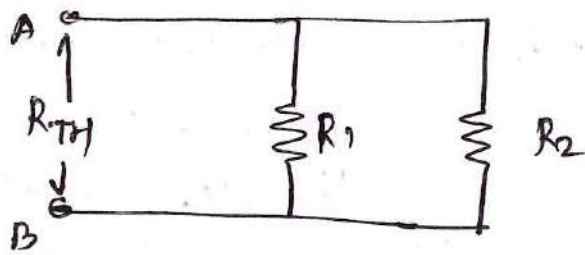
Step 1:- The voltage V_{OC} or V_{TH} is obtained by removing branch AB (R_3) & measure open circuit voltage between A & B i.e V_{OC}

$$V_{OC} = V_{AB}$$



Step 2:- Find R_{TH} . Which is measure between terminal A & B , when voltage source replaced by S.C & current source replace by O.C

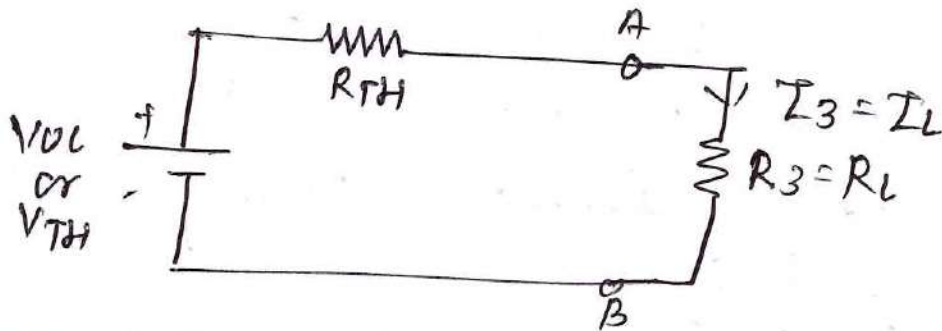




$$R_{TH} = R_1 \parallel R_2$$

$$R_{TH} = \frac{R_1 R_2}{R_1 + R_2} \quad \Omega$$

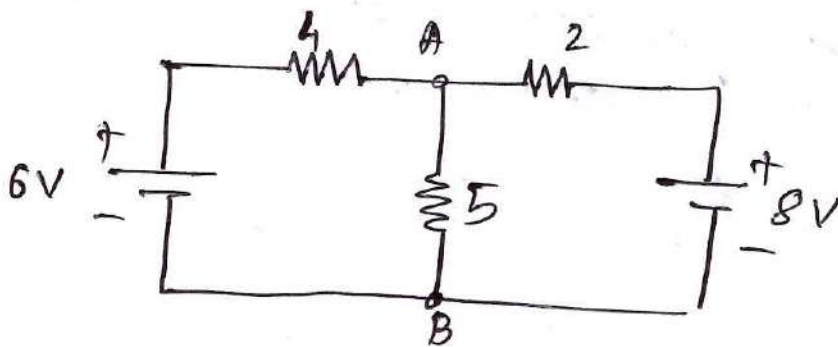
Step 3:- Draw thevenin equivalent circuit with connect remove branch



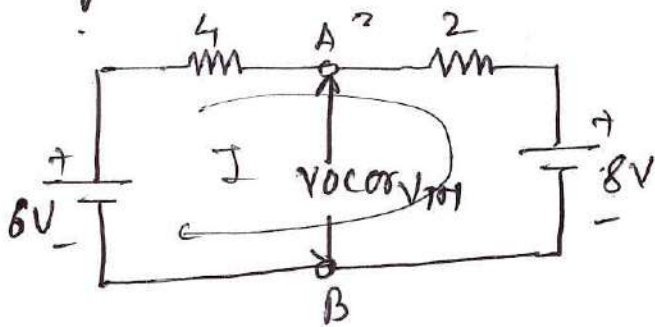
current flowing through R_3 determine by

$$I_3 = I_L = \frac{V_{oc}}{R_L + R_{TH}} \quad \text{Amp}$$

Q. Find current flowing through branch AB by using thevenin theorem.



Step 1: Remove branch AB & measure Voc or VTH



Find out current flowing through circuit

$$-4I - 2I - 8 + 6 = 0$$

$$-6I - 2 = 0$$

$$-6I = 2$$

$$I = \frac{-2}{6} = 0.333 \text{ A} \quad (5)$$

$$V_{OC} = V_A - V_B = \therefore V_A - 4I - 6 = V_B$$

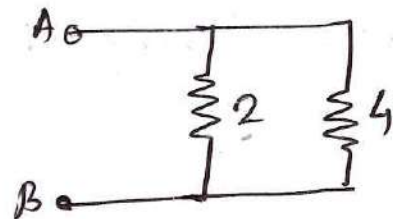
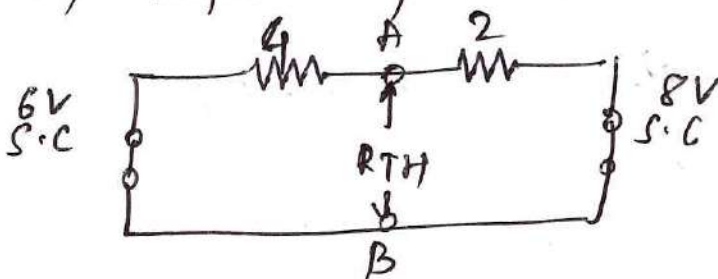
$$V_A - 4(0.333) - 6 = V_B$$

$$V_A - 1.33 - 6 = V_B$$

$$V_A - 7.333 = V_B$$

$$V_{OC} = V_A - V_B = 7.333 \text{ Volt}$$

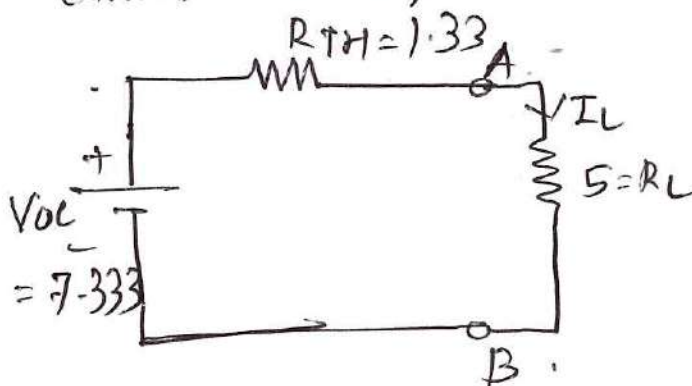
Step 2: Thevenin's equivalent resistance obtained by Replace by 6V & 8V sources by S.C



$$R_{TH} = 2 \parallel 4$$

$$R_{TH} = \frac{2 \times 4}{2 + 4} = \frac{8}{6} = 1.33 \Omega$$

Step 3: Thevenin equivalent circuit for obtaining current flowing through branch AB



$$I_L = \frac{V_{OC}}{R_{TH} + R_L}$$

$$= \frac{7.333}{(1.33 + 5)}$$

$$I_L = 1.158 \text{ AMP}$$

The current flowing through AB (5Ω) is 1.158 A

$$-0.33V_1 - 0.5V_1 - 0.33V_1 = 1.67 - 2$$

$$-1.167 V_1 = -3.67$$

$$V_1 = \frac{-3.67}{-1.167} = \frac{3.67}{1.167}$$

$$V_1 = 3.1448 \text{ Volt}$$

Step 3:- calculate current flowing through 3Ω

$$I_3 = \frac{V_1}{3} = \frac{3.1448}{3}$$

$$I_3 = 1.0482 \text{ Amp}$$

step II Apply KCL at node V_1

Incoming current = Out going current

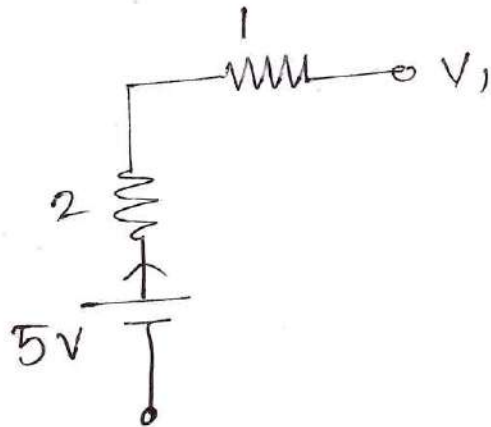
$$I_1 + I_2 = I_3$$

According to ohm's law = $\frac{\text{Voltage difference}}{\text{current}}$

Find out I_1

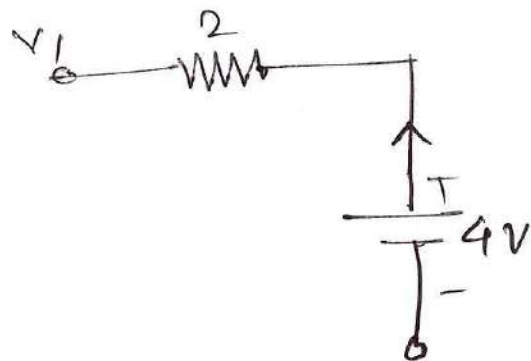
$$I_1 = \frac{5 - V_1}{2 + 1}$$

$$I_1 = \frac{5 - V_1}{3}$$



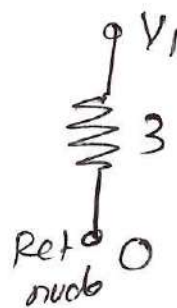
Find out I_2

$$I_2 = \frac{4 - V_1}{2}$$



Find out I_3

$$I_3 = \frac{V_1 - 0}{3}$$
$$= \frac{V_1}{3}$$



Put values of I_1 , I_2 & I_3 in equation (3)

$$\frac{5 - V_1}{3} + \frac{4 - V_1}{2} = \frac{V_1}{3}$$

$$\frac{5}{3} - \frac{V_1}{3} + \frac{4}{2} - \frac{V_1}{2} = \frac{V_1}{3}$$

$$1.67 - 0.33V_1 + 2 - 0.5V_1 = 0.33V_1$$

Nodal Analysis (Node voltage Method)

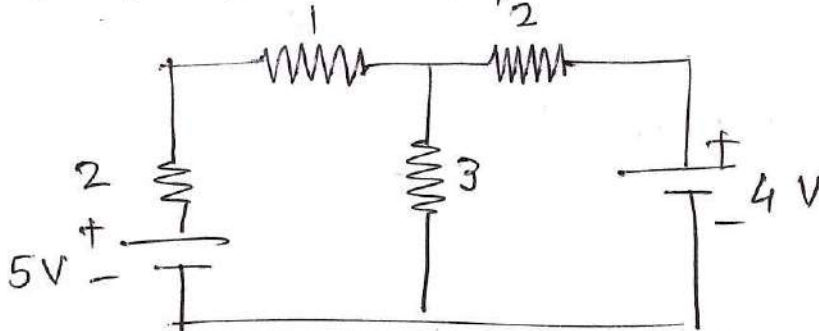
This analysis is carried to determine voltages at different node

Nodal Analysis is done by using KCL

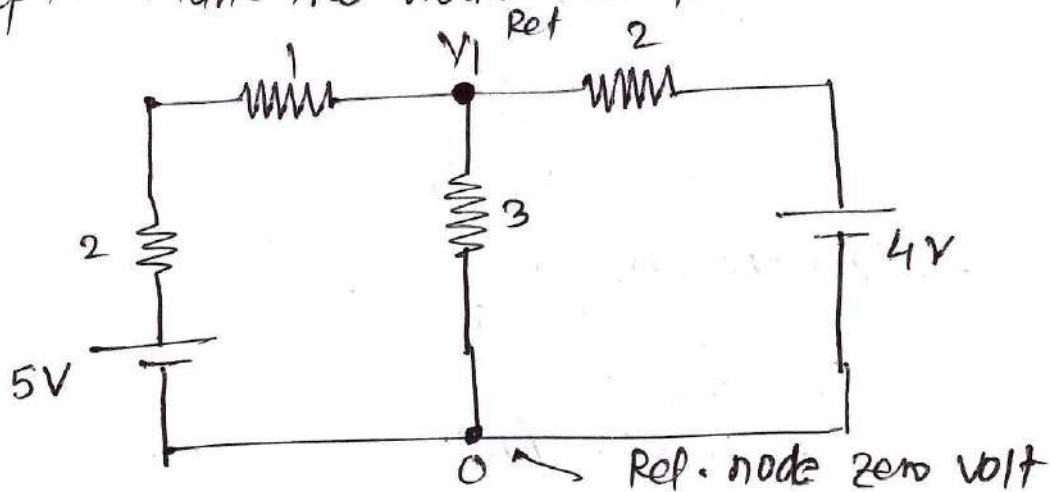
steps.

1. Identify & mark all the nodes (including reference) node & corresponding node voltage
2. Mark all the branch current.
3. Apply KCL at each node. That means write equation of current at each node.
Note that current always flow from Higher potential to lower potential.
4. solve equation to calculate unknown voltage or current.

Using Node Analysis find current in 3Ω resistor for circuit shown in figure



Step 1 - Mark the node voltage & branch current



Step II - Apply KVL to Mesh ABEF-A

$$-5I_1 - 6(I_1 - I_2) + 20 = 0$$

$$-5I_1 - 6I_1 + 6I_2 = -20$$

$$-11I_1 + 6I_2 = -20 \quad \text{--- (1)}$$

Apply KVL to Mesh BCDE-B

$$-10I_2 - 15 - 6(I_2 - I_1) = 0$$

$$-10I_2 - 15 - 6I_2 + 6I_1 = 0$$

$$6I_1 - 16I_2 = 15 \quad \text{--- (2)}$$

Step III - solve equation (1) & (2) simultaneously

$$-11I_1 + 6I_2 = -20 \quad \text{--- (1) } \times 6$$

$$6I_1 - 16I_2 = 15 \quad \text{--- (2) } \times 11$$

$$-66I_1 + 36I_2 = -120 \quad \text{--- (1)}$$

$$+ 66I_1 - 176I_2 = 165 \quad \text{--- (2)}$$

$$-140I_2 = 45$$

$$I_2 = \frac{45}{-140}$$

$$I_2 = -0.321 \text{ Amp}$$

Put in equation (1)

$$-11I_1 + 6(-0.321) = -20$$

$$-11I_1 - 1.926 = -20$$

$$-11I_1 = -20 + 1.926$$

$$-11I_1 = -18.074$$

$$I_1 = \frac{18.074}{11}$$

$$I_1 = 1.643 \text{ Amp}$$

Current flowing through 6Ω is $I_1 - I_2$

$$= 1.643 - (-0.321)$$

$$= 1.643 + 0.321$$

$$= 1.964 \text{ Amp}$$

Consider I_1 & I_2 current flowing through Mesh ① & ② in clockwise direction

Step 2: Apply KVL to Mesh ABEF: A

$$-R_1 I_1 - R_3 (I_1 - I_2) + V_1 = 0$$

$$-R_1 I_1 - R_3 I_1 + R_3 I_2 = -V_1$$

$$-I_1 (R_1 + R_3) + R_3 I_2 = -V_1 \quad \text{--- (1)}$$

Apply KVL to Mesh BCDE: B

$$-R_2 I_2 - V_2 - R_3 (I_2 - I_1) = 0$$

$$-R_2 I_2 - V_2 - R_3 I_2 + R_3 I_1 = 0$$

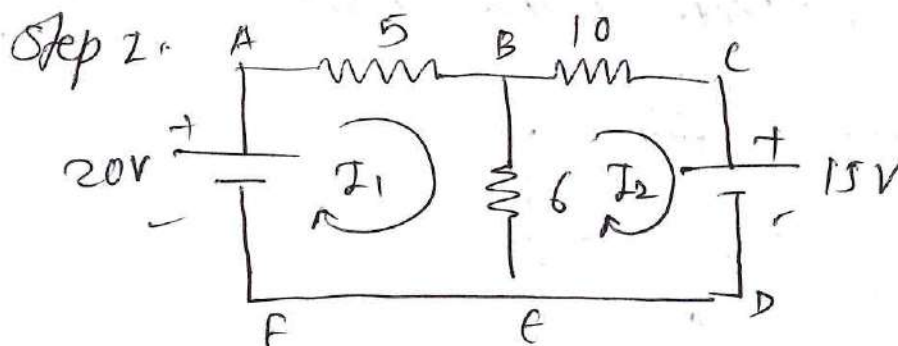
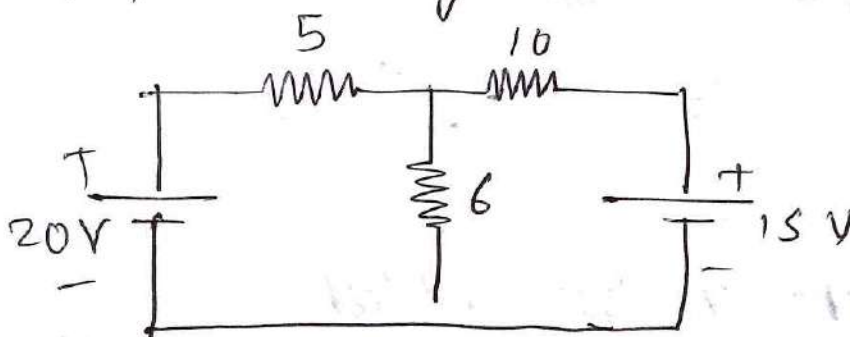
$$R_3 I_1 - I_2 (R_2 + R_3) = V_2 \quad \text{--- (2)}$$

Step 3:-

Solve equation ① & ② simultaneously

And the values of I_1 & I_2

Q. Calculate current flowing through 6- Ω resistor by using Mesh Analysis.



Mesh Analysis

Step 1: Identify the loop in given circuit i.e Mesh & Mark the loop current. The direction of loop current in clockwise direction.

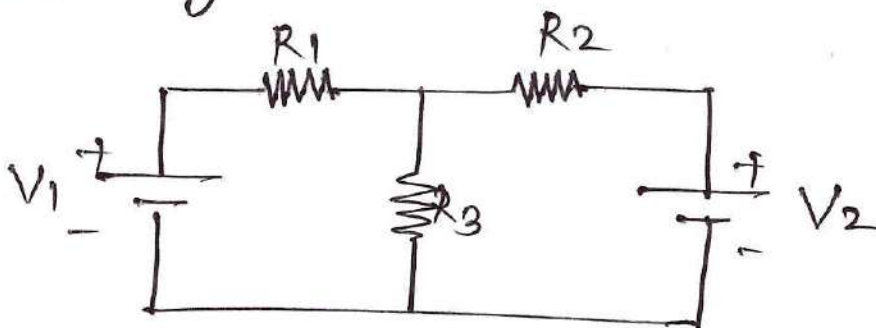
Strictly follow the direction of loop current & across each resistor mark the polarities of voltage drop

Step 2: Apply KVL for each loop & generate the equation. The no. of loop equation should be equal to no. of unknowns

Step 3: Solve the loop equation simultaneously & calculate value of loop current & also using ohm's law calculate unknown voltage

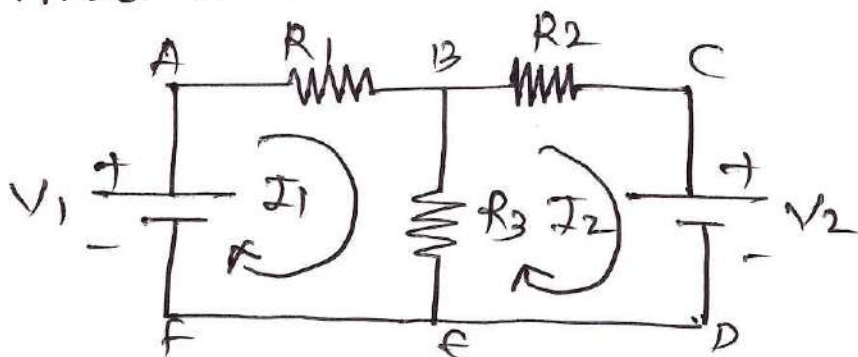
Example: (Explanation)

Calculate current flowing through R_3 by using Mesh Analysis



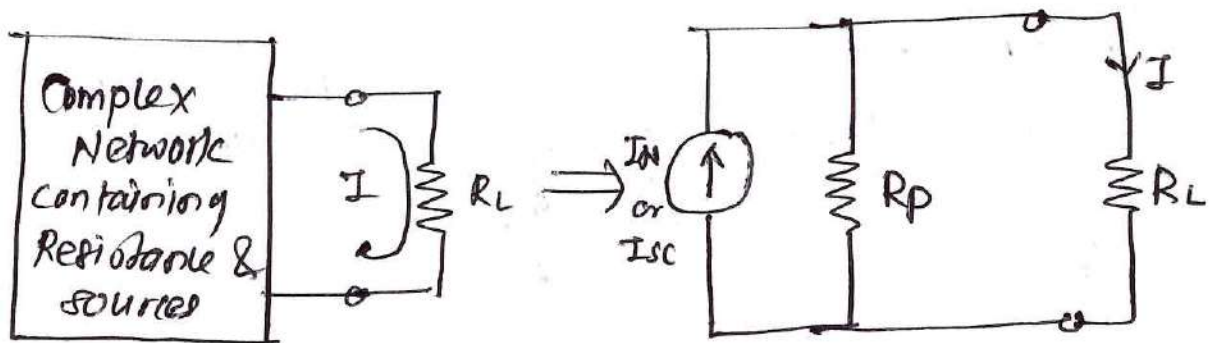
Step 1: Identify the loop or Mesh

There are two Mesh in the circuit i.e ABEF-A & BCDE-B



Norton's Theorem:

An linear Network containing one or more voltages or current source can be replaced by an equivalent circuit containing a current source called Norton's equivalent current (I_N) & equivalent resistance in parallel (R_p or R_N)



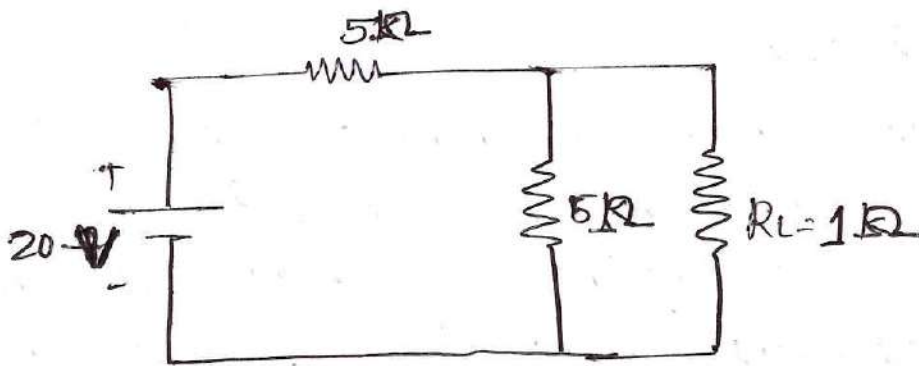
Steps

- ① Short circuit the branch whose current we have to find out. calculate I_{sc} by using Kirchhoff's law
- ② calculate R_p or R_N (Thevenin equivalent resistance)
- ③ Joined the remove branch, calculate flowing current through branch

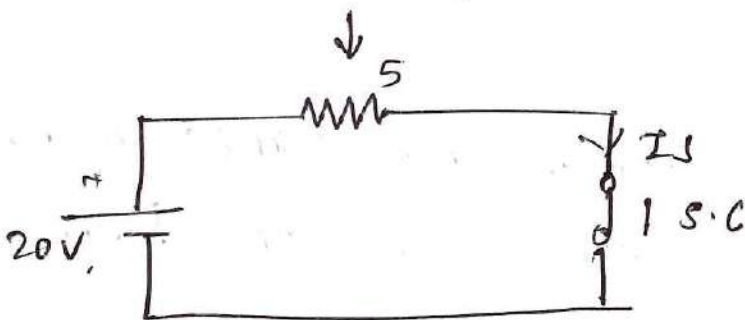
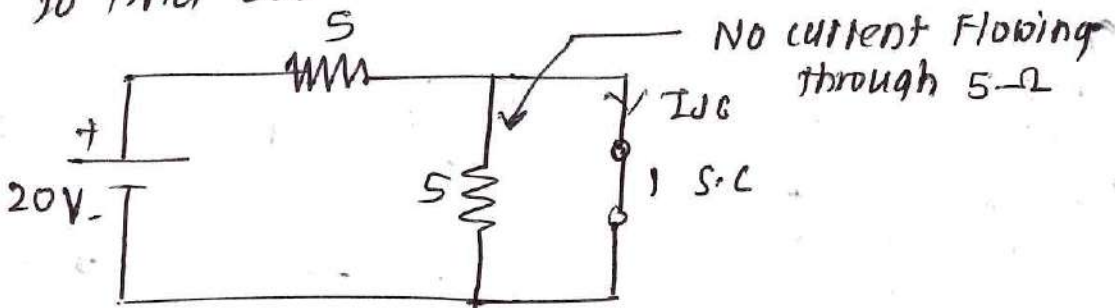
$$I = I_{sc} \times \frac{R_p}{R_p + R_L} \text{ Amp}$$

Example.

Using Norton's theorem calculate current flowing through load resistance R_L

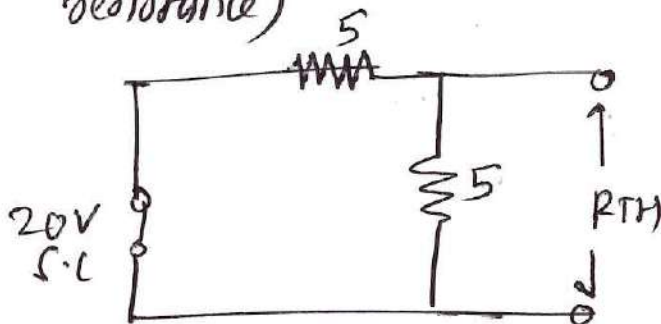


Step 1: Short the branch whose current we have to find out



$$I_{sc} = I = \frac{V}{5 + 0} = \frac{20}{5} = 4 \text{ Amp}$$

Step 2: find out R_{TH} or R_p (Thevenin equivalent resistance)



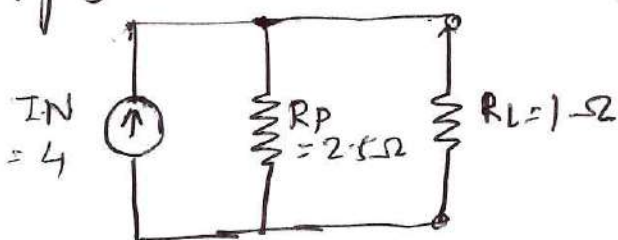
$$R_{TH} = 5\Omega \parallel 5\Omega$$

$$R_{TH} = R_p = \frac{5 \times 5}{5 + 5}$$

$$= \frac{25}{10}$$

$$R_p = 2.5\Omega$$

Step 3: Drawn Norton equivalent Network.



$$I_L = I_{sc} \times \frac{R_{TH}}{R_p + R_L}$$

$$= 4 \times \frac{2.5}{2.5 + 1}$$

$$I_L = 2.857 \text{ Amp}$$

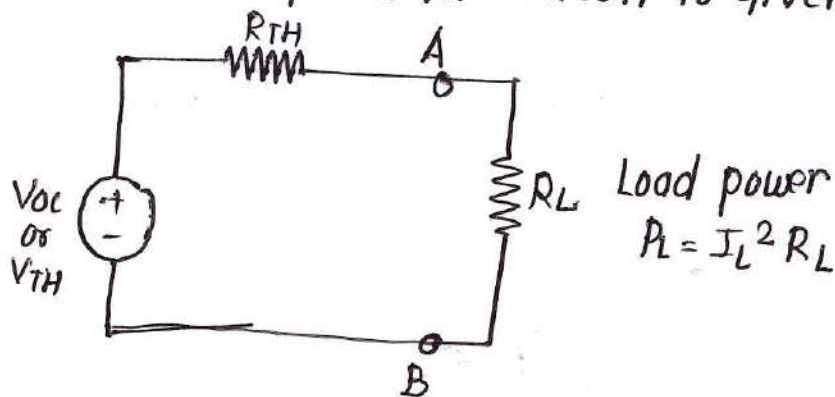
Maximum Power Transfer Theorem

Statement: The maximum amount of power will be delivered to the load resistance when the load resistance equal to the thevenin/ Norton resistance of the Network

$$\therefore R_L = R_{TH}$$

Condition for Maximum power transfer

Thevenin equivalent circuit is given by



Then condition for maximum power transfer to the load is given by

$$R_L = R_{TH}$$

$$I = \frac{V_{OC}}{R_L + R_{TH}}$$

Put $R_L = R_{TH}$

$$I = \frac{V_{OC}}{R_L + R_L} = \frac{V_{OC}}{2R_L}$$

Power delivered to load

$$P_{Lmax} = I_L^2 R_L = \left[\frac{V_{OC}}{2R_L} \right]^2 \times R_L$$

$$= \frac{V_{OC}^2}{4R_L^2} \times R_L$$

$$\boxed{P_{Lmax} = \frac{V_{OC}^2}{4R_L}}$$

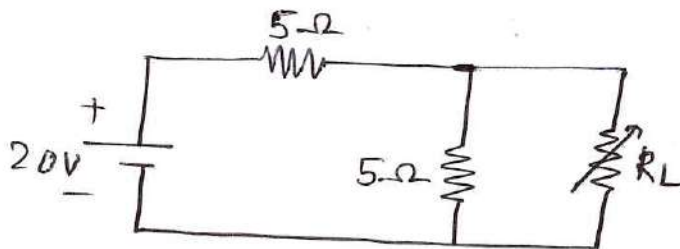
Application

- ① Power Amplifier
- ② Impedance matching in electrical circuits.

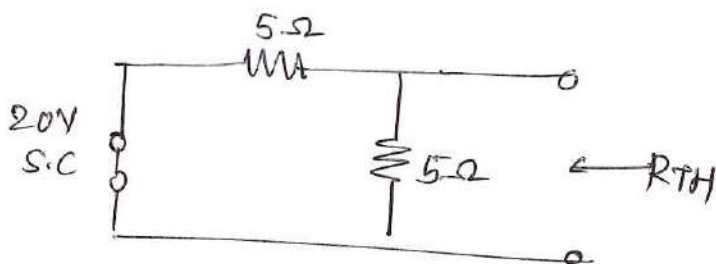
Steps (Procedure)

- ① obtain V_{OC} & R_{TH} for the given Network
- ② obtain the value of $R_L = R_{TH}$ for maximum power transfer.
- ③ calculate the maximum load power.

Q. Find the value of load resistance R_L to get maximum power transfer to it.



we have to find the value of thevenin equivalent resistance R_{TH}

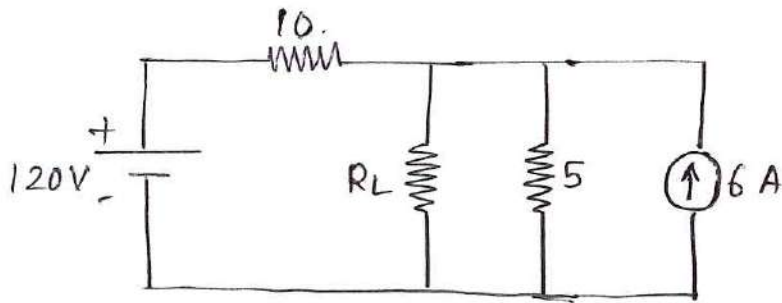


$$R_{TH} = 5 \parallel 5 = \frac{5 \times 5}{5 + 5} = \frac{25}{10} = 2.5 \Omega$$

For maximum power transfer

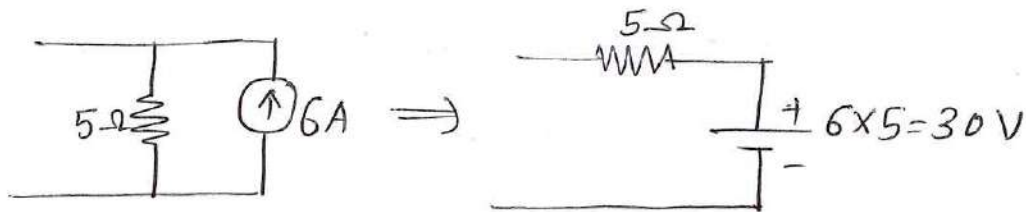
$$R_L = R_{TH} = 2.5 \Omega$$

Q.



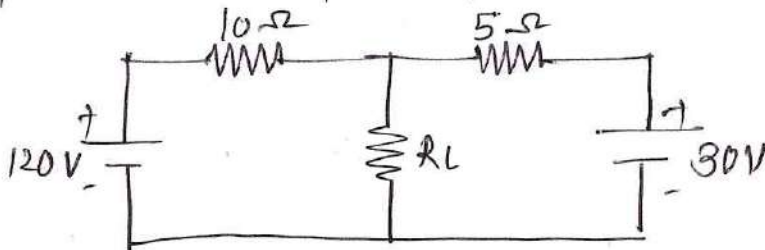
- ① The value of load resistance R_L to give maximum power transfer
- ② The power delivered to load.

Step 1. Convert current source into equivalent voltage source

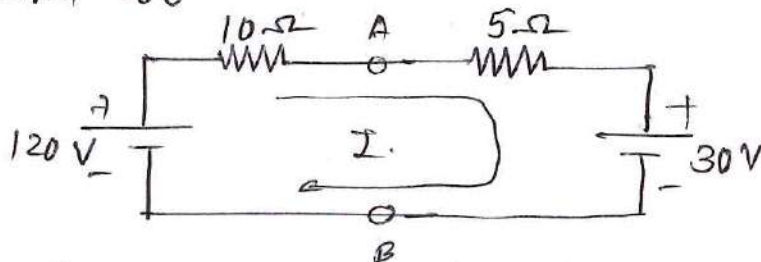


$$V = IR = 6 \times 5 = 30 \text{ Volt}$$

Step 2: Draw again equivalent circuit



Find V_{OC}



Apply KVL

$$-10I - 5I - 30 + 120 = 0$$

$$-15I + 90 = 0$$

$$15I = 90$$

$$I = \frac{90}{15} = 6A$$

$$V_{OC} = V_A - V_B =$$

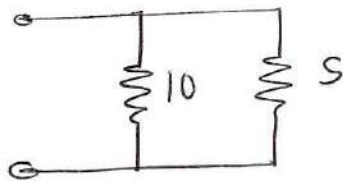
$$\therefore V_A = 5I + 30 = V_B$$

$$V_A - V_B = -120 + 10(6)$$

$$= -120 + 60$$

$$V_A - V_B = -60 = 60V$$

Find R_{TH}



$$R_{TH} = 10 \Omega \parallel 5 \Omega$$

$$= \frac{10 \times 5}{10 + 5}$$

$$= \frac{50}{15}$$

$$R_{TH} = 3.33 \Omega$$

Reciprocity Theorem:

In any linear Network, the ratio of voltage V introduced in one loop to the current I in other loop is same as the ratio obtained if the position of V & I are interchange in the Network.

Steps (Procedure)

- ① Consider a Network shown in figure (a) it consist of voltage source in branch A-B. The output current of network is the current passing through CD.

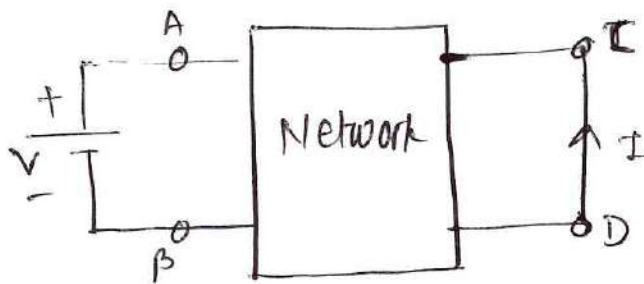


Fig (a)

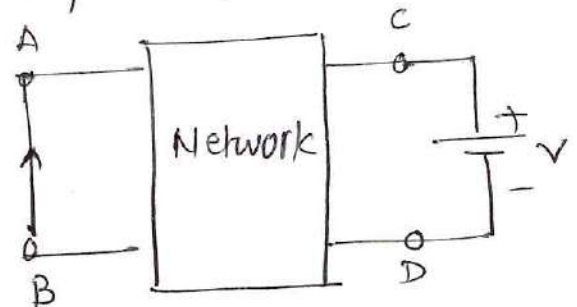


Fig (b)

→
position of V & I
interchanged

- ② Using any N/w simplification technique, the ratio of voltage to current $(\frac{V}{I})$ can be obtained.
- ③ As shown in figure (b), voltage source (V) is now connected in branch CD & current passing through branch AB
- ④ The ratio of V/I is calculated. Both cases the ratio of V/I remain same.

⑤ So, there is two network are said to be reciprocal

⑥ The ratio V/I is called transfer impedance.

Advantages.

- ① It proves bilateral property
- ② To solve DC & AC Network

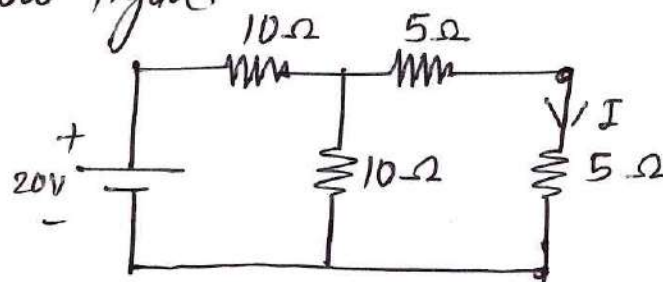
Disadvantages

- ① Can not be applied the circuit containing time variant element
- ② Theorem can not be applied to dependent source.
- ③ Theorem can not be applied to non-linear element

Application

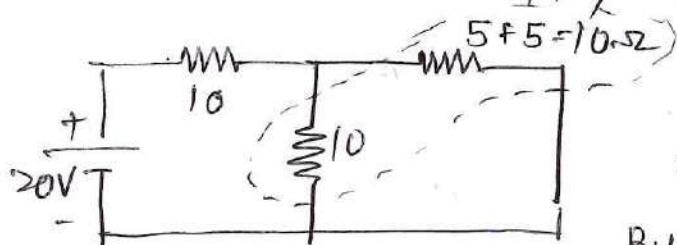
- ① Used to Analyse AC & DC Network.
- ② It is used to check transmitting & receiving signal of an Antenna.

Q. Verify the reciprocity theorem for Network as shown in below figure.



① Calculate the ratio V/I

To calculate I apply by using KVL

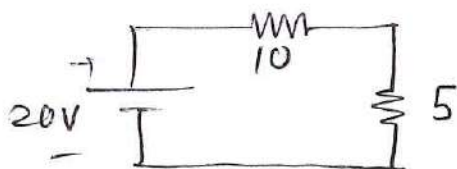


$$5 \& 5 \text{ in series} = 5 + 5 = 10$$
$$10 \parallel 10$$
$$= \frac{10 \times 10}{10 + 10} = \frac{100}{20} = 5 \Omega$$

By using KVL

$$I = \frac{20}{10 + 5} = \frac{20}{15}$$

$$I = 1.333 \text{ A}$$



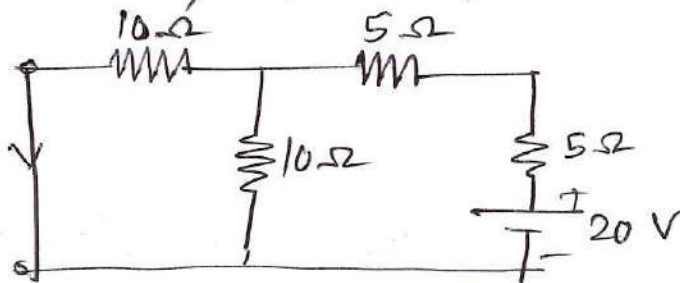
The ratio of $\frac{V}{I} = \frac{20}{1}$

The current flowing through 5Ω resistance is

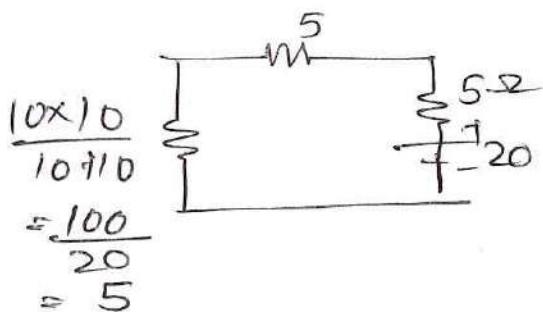
$$I = \text{total current} \times \frac{10}{10+10}$$
$$= 1.333 \times \frac{10}{20} = 1.333 \times 0.5$$
$$I = 0.666 \text{ A}$$

The ratio of $\frac{V}{I} = \frac{20}{0.666} = 30.03 \text{ A} \quad \text{--- (1)}$

(2) Interchange position of V & I



$10\Omega \parallel 10\Omega$



Apply KVL to ckt

$$I = \frac{20}{5+5+5} = \frac{20}{15}$$

$$I = 1.333 \text{ A}$$

current flowing through 10Ω resistance is

$$I = \text{total current} \times \frac{10}{10+10}$$
$$= 1.33 \times \frac{10}{20} = 0.666 \text{ A}$$

The ratio of $\frac{V}{I} = \frac{20}{0.666} = 30.03 \text{ A}$

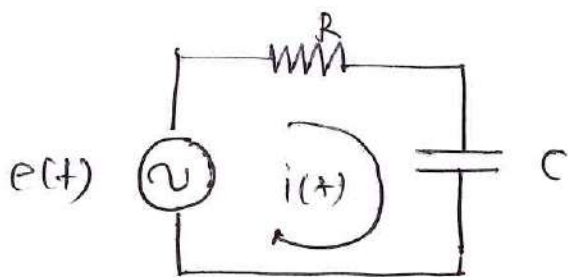
from equation (1) & (2) value are same means reciprocity theorem verify.

AC Network Theorem

AC network theorem are mathematical laws used to analyze alternating current circuits by simplifying complex arrangement of impedances & power sources.

Initially apply KVL & KCL determine equilibrium equation of Network

then replace each element by its dual element



Step I - Apply KVL to given network

$$e(t) = R \cdot i(t) + \frac{1}{C} \int i(t) dt \quad \text{--- (1)}$$

Step II. Replace each element by its dual element as follows

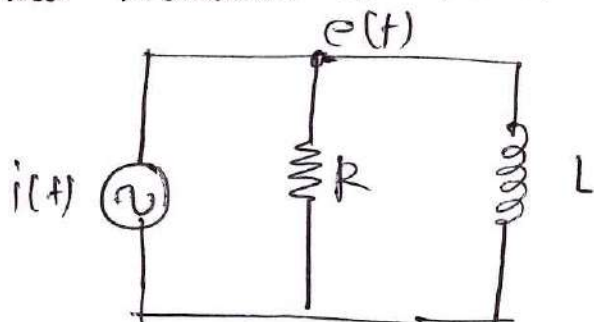
$$e(t) \longleftrightarrow i(t) \qquad R \longleftrightarrow G$$

$$C \longleftrightarrow L$$

Then eq. (1) becomes.

$$i(t) = G \cdot e(t) + \frac{1}{L} \int e(t) dt \quad \text{--- (2)}$$

Step III with the help of new equilibrium equation (2) & dual Network as shown in figure



Equation (2) is KCL equation. So every term represent current value & G conductance = $\frac{1}{R}$ The node voltage is denoted $e(t)$.

Unit - V Network Theorems

Subject: ECN (313332)

1. State Maximum Power Transfer theorem. 2 marks (s-2025) (w-2025)
2. State reciprocity theorem. 2 marks (w-2024) (w-2025)
3. State any two differences between DC Network and AC Network theorems. 2 marks (w-2024)
4. Write stepwise procedure for applying Thevenin's theorem to simple circuits. (Assume simple circuit) 4 marks (w-2025)
5. Calculate the value of R which will absorb maximum power from the circuit of Figure No. 4. 4 marks (w-2025)

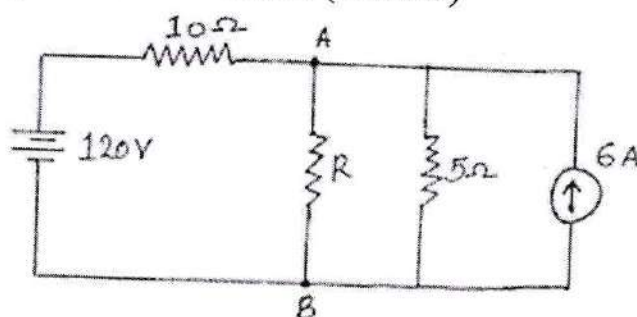


Fig. No. 4

6. Using Thevenin's theorem, calculate the potential difference across terminals A and B in Fig. No. 2. 4 marks (s-2025)

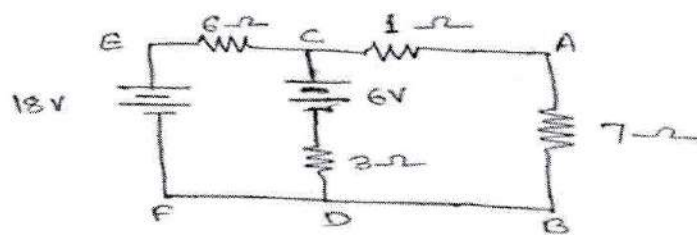


Fig. No. 2

7. State and explain Reciprocity Theorem. 4 marks (s-2025)
8. With the help of superposition theorem, compute the current flowing between points A and B for the Figure No. 3. 4 marks (w-2024)

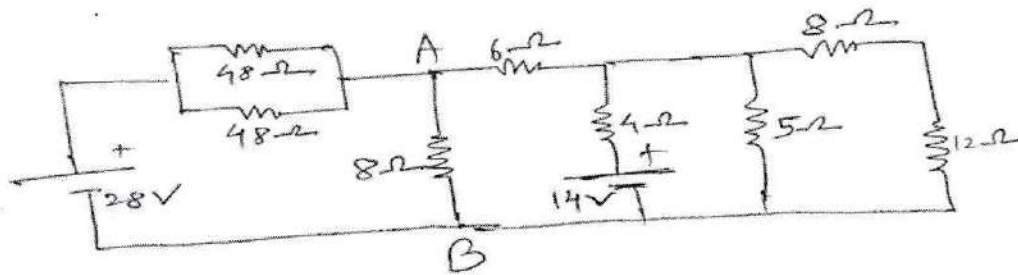


Fig. No. 3

9. State Thevenin's theorem. Draw Thevenin's equivalent circuit. State why Thevenin's theorem is convergent of Norton's theorem. 4 marks (w-2024)

10. Find the Norton equivalent circuit for the active linear network as shown in Figure No. 4. 4 marks (w-2024)

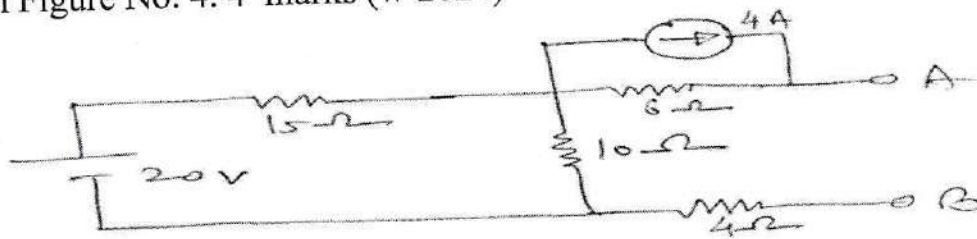


Fig. No. 4

11. Find I_L for the circuit shown in Fig. No. 3 using superposition theorem. 6 marks (s-2025)

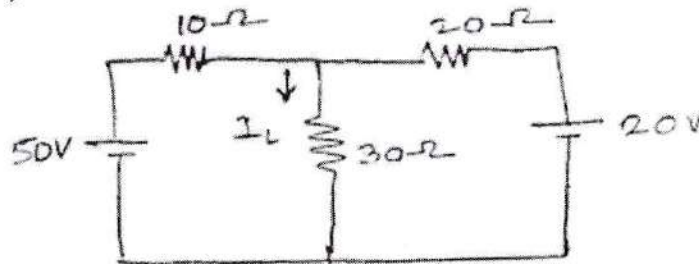


Fig. No. 3

12. Use Norton's theorem to find the current through 3Ω resistance, for the circuit shown in Fig. No. 4. 6 marks (s-2025)

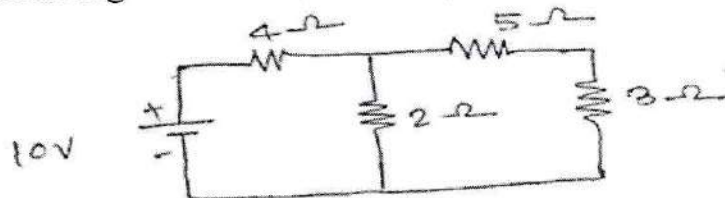


Fig. No. 4

13. Apply superposition theorem to compute current I in the network shown in Figure No. 5. 6 marks (w-2025)

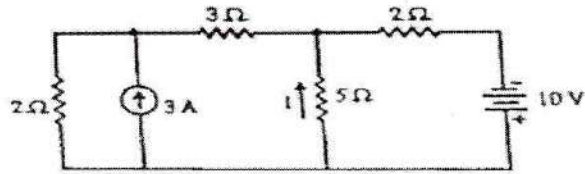


Fig. No. 5

14. By Norton's theorem, find the current in 4Ω resistor in the network shown in Figure No. 6. 6 marks (w-2025)

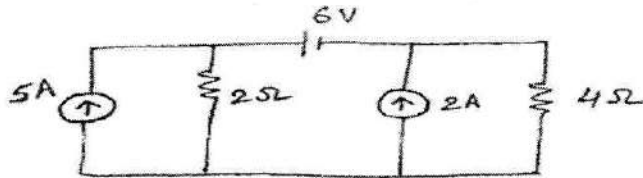


Fig. No. 6

15. For the circuit shown in Figure No. 6. Find the magnitude and direction of the current in the 2Ω resistor by using Thevenin's theorem. 6 marks (w-2024)

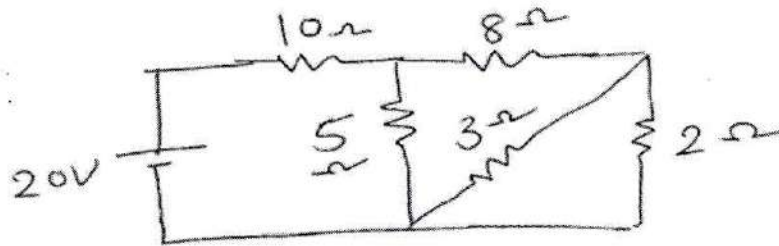


Fig. No. 6

16. State maximum power transfer theorem. Prove that $P_{Lmax} = \frac{(V_{th})^2}{4R_L}$ in the circuit. 6 marks (w-2024)