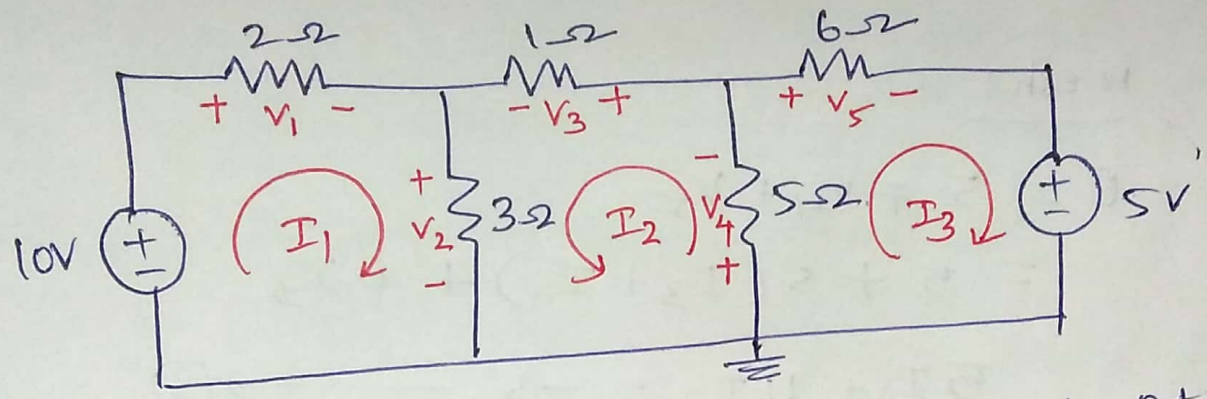
EEE1001 - LECTURE #5

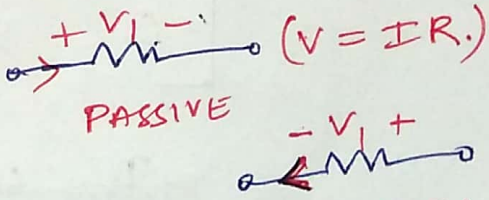
MESH ANALYSIS

- Identify mesh currents and solve using KVL & OHMS LAW.
- I is variable to be found.



Nodes = 5 Branches = 7 loops = b − n + 1 = 3.

Assign polarity for voltage across all branches and name them.



mesh 1

ACTIVE V = PASSIVE V

$10 = V_1 + V_2$

$10 = 2I_1 + 3(I_1 + I_2)$

$10 = 5I_1 + 3I_2$ ⟶ (1)

(2)

mesh 2

$0 = V_3 + V_2 + V_4$.

$0 = I_2(1) + 3(I_2 + I_1) + 5(I_2 + I_3)$

$0 = I_2 + 3I_2 + 3I_1 + 5I_2 + 5I_3$.

$3I_1 + 9I_2 + 5I_3 = 0 \longrightarrow (2)$.

mesh 3

$0 = 5 + V_4 + V_5$

$= 5 + 5(I_3 + I_2) + 6I_3$

$5I_2 + 11I_3 = -5 \longrightarrow (3)$

solution.

$$\begin{bmatrix} 5 & 3 & 0 \\ 3 & 9 & 5 \\ 0 & 5 & 11 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ -5 \end{bmatrix}$$

~~$I_1 = 2.76 \quad I_2 = -1.27 \quad I_3 = 0.124$~~

$V_2 = 3(I_2 + I_1)$

$V_2 = 5.091$

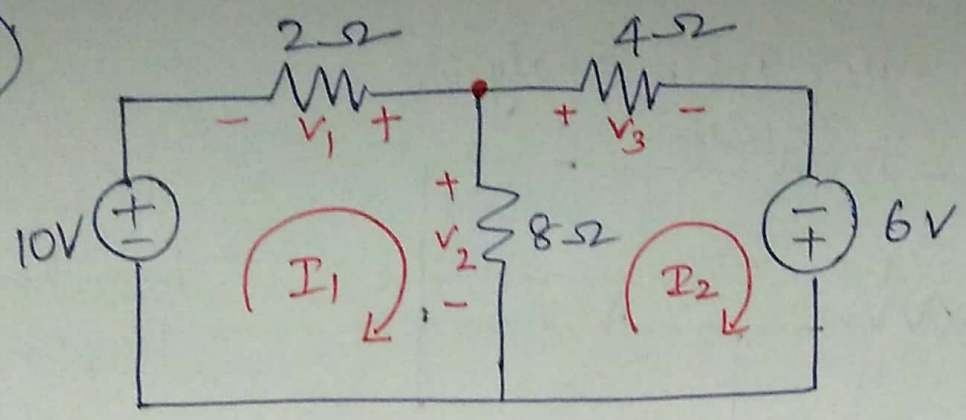
$V_4 = 5(I_2 + I_3)$

$V_4 = 2.601$.

$= 4.335$

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 2.453 \\ -0.756 \\ -0.111 \end{bmatrix}$$

(2)



nodes = 4 branches = 5 loops = 5 − 4 + 1 = 2

mesh 1

Active = Passive.

$10 + V_1 = V_2$

$10 - 2I_1 = 8(I_1 - I_2)$

$10 = 10I_1 - 8I_2 \rightarrow (1)$

mesh 2

Active V = Passive V

$V_2 + 6 = V_3$

$-8(I_2 - I_1) + 6 = 4I_2$

$8I_1 - 12I_2 = -6$

$4I_1 - 6I_2 = -3 \rightarrow (2)$

Solving (1), (2) we get,

$40I_1 - 32I_2 = 40$

$40I_1 - 60I_2 = -30$

$28I_2 = 70$

$I_2 = 2.5\ A$

then $I_1 = \frac{10 + 8I_2}{10}$

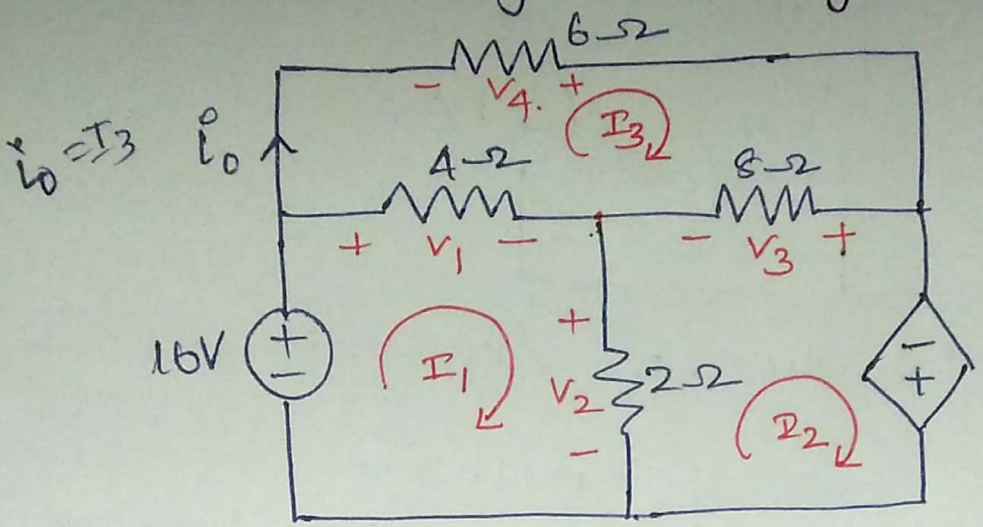
$I_1 = 3\ A$

$V_2 = 8(I_1 - I_2)$

$V_2 = 4\ V$

Other voltages and branch currents can be found using I_1 & I_2.

(3) Find I_o using mesh analysis.



nodes = 4
branches = 6
loops = 3
(6-4+1)

$10 i_o$. (dependent voltage source)

mesh 1 Active voltages = Passive voltages.

$$16 = V_1 + V_2$$

$$16 = 4(I_1 - I_3) + 2(I_1 - I_2)$$

$$= 4I_1 - 4I_3 + 2I_1 - 2I_2$$

$$16 = 6I_1 - 2I_2 - 4I_3 .$$

mesh 2

$$V_2 + V_3 + 10 i_o = 0$$

$$-2(I_2 - I_1) + 8(I_2 - I_3) + 10 I_3 = 0$$

$$2I_1 - 10I_2 + 18 I_3 = 0$$

mesh 3

$$V_1 + V_4 = V_3$$

$$-4(I_3 - I_1) + 6(I_3) = 8(I_3 - I_2)$$

$$-4I_3 + 4I_1 - 6I_3 - 8I_3 + 8I_2 = 0$$

$$4I_1 + 8I_2 - 18 I_3 = 0$$

Solving the equations.

$$\begin{bmatrix} 6 & -2 & -4 \\ 2 & -10 & 18 \\ 4 & 8 & -18 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 16 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} -2.57 \\ -7.71 \\ -4. \end{bmatrix}$$

$$I_o = -4\,A$$