Adwait Naravane
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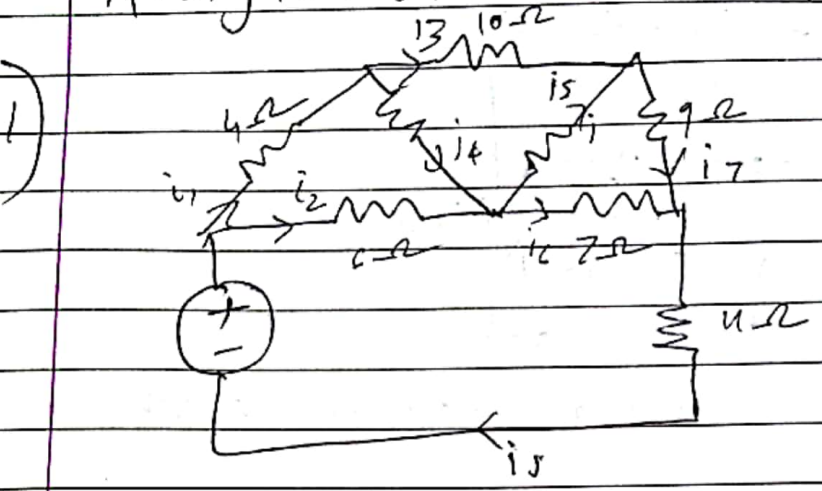
Assignment – I. PH3104.



KCL & KVL equations →

$i_1 = i_3 + i_4$

$i_2 + i_4 = i_5 + i_6$

$i_7 = i_3 + i_5$, $i_1 + i_2 = i_5$

$4i_1 + 8i_4 - 6i_2 = 0$

$10 i_3 - 5i_5 - 8i_4 = 0$

$9 i_7 + 5i_5 - 7i_6 = 0$

$6 i_2 + 7i_6 + 11(i_1 + i_2) = 65$

7 equations with 7 unknowns.

$I = [\, i_1 \; i_2 \; i_3 \; i_4 \; i_5 \; i_6 \; i_7 \,]^T$

$AI = D$

$$A = \begin{bmatrix} 1 & 0 & -1 & -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & -1 & -1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & -1 \\ 4 & -6 & 0 & 8 & -3 & 0 & 0 \\ 0 & 0 & 10 & -8 & 0 & -7 & 9 \\ 0 & 0 & 0 & 0 & 0 & 7 & 0 \\ 11 & 17 & 0 & 0 & 0 & 7 & 0 \end{bmatrix} \quad D = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 65 \end{bmatrix}$$

We solve this using some linalg library or lin eq solver (doesn't matter)

$i_1 = 1.5305$ A, $i_2 = 1.957$ A

turns out to be values for i_1, i_2.

$i_5 = i_1 + i_2 = 3.4875$ A

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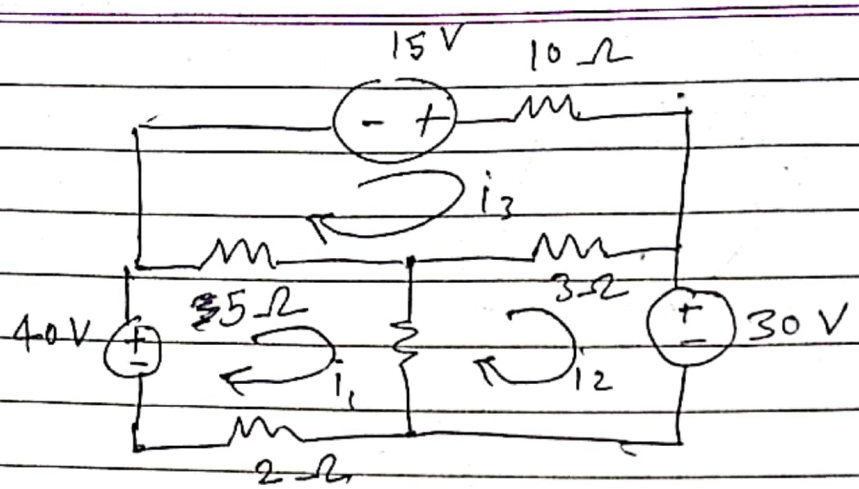
2)



Using Maxwell mesh.

$$15 = (10+8+3)\,i_3 - 3i_2 - 5i_1$$
$$40 = (2+6+5)\,i_1 - 6i_2 - 5i_3$$
$$30 = 9i_2 - 6i_1 - 3i_3$$

Here $\Pi = (i_1\ i_2\ i_3)^T$

$$A\Pi = D$$

$$A = \begin{pmatrix} -5 & -3 & 18 \\ -6 & 9 & -3 \\ 13 & -6 & -5 \end{pmatrix} \quad D = \begin{pmatrix} 15 \\ 30 \\ 40 \end{pmatrix}$$

Solving this we get

$i_1 = 11.4904$ A, $i_2 = 13.0609$ A.

$i_3 = 6.2019$ A.

Current through.

$R = 3\Omega \Rightarrow |I_3 - i_2| = 6.8589$ A to right.

$R = 10\Omega \Rightarrow i_3 = 6.2019$ A

$R = 5\Omega \Rightarrow |i_1 - i_3| = 5.2885$ A. to right

$R = 6\Omega \Rightarrow |i_1 - i_2| = 1.5705$ A upward.

$R = 2\Omega \Rightarrow i_1 = 11.4904$ A.

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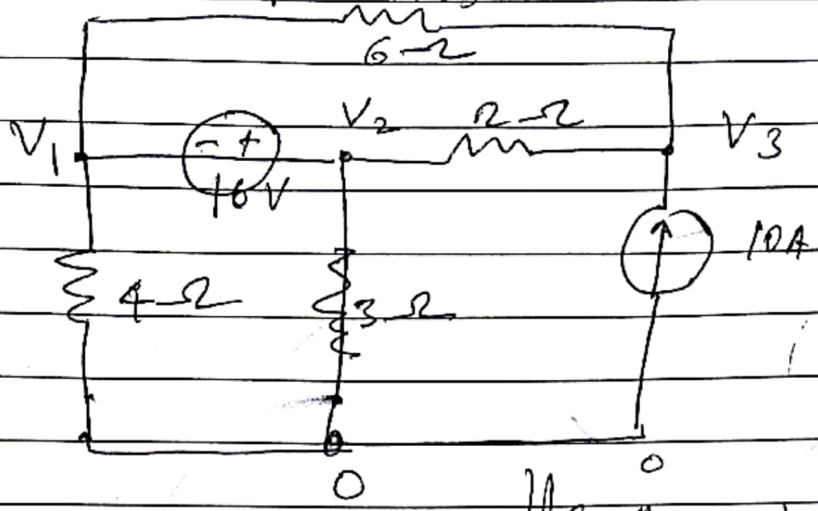
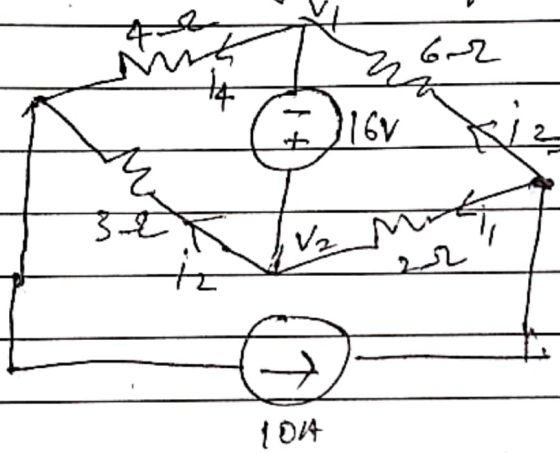
3) Norton's method:—

Potentials at nodes.



An equivalent circuit.



$V_2 - V_1 = 16$.

$\frac{V_2}{3} + \frac{V_1}{4} = 10$

$\frac{V_3 - V_2}{2} + \frac{V_3 - V_1}{6} = 10$.

$AV = D$

$$A = \begin{pmatrix} -1 & 1 & 0 \\ -1/6 & -1/2 & 2/3 \\ 1/4 & 1/3 & 0 \end{pmatrix} \qquad D = \begin{pmatrix} 16 \\ 10 \\ 10 \end{pmatrix}$$

$\Rightarrow V_1 = 8\,V, \quad V_2 = 24\,V, \quad V_3 = 35\,V$

$i_1 = \frac{V_3 - V_2}{2} = \frac{11}{2}\,A, \quad i_3 = \frac{V_3 - V_1}{6} = \frac{9}{2}\,A,$

$i_2 = \frac{V_2}{3} = 8\,A, \quad i_4 = \frac{V_1}{4} = 2A.$