YAKUBU NATHAN BALA

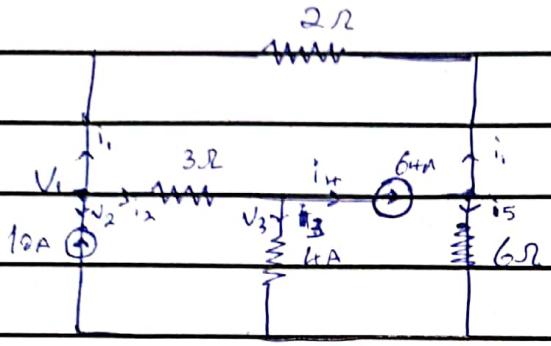
17/ENG04/076

ELECT/ELECT

EEE322

ASSIGNMENT

1.)



At node 1:

KCL: $10 = i_1 + i_2 = \frac{V_1 - V_3}{2} + \frac{V_1 - V_2}{3}$

$60 = 2(V_1 - V_2) + 3(V_1 - V_3)$

$60 = 2V_1 - 2V_2 + 3V_1 - 3V_3$

$60 = 5V_1 - 2V_2 - 3V_3$ ... (1)

At node 2:

$i_2 = i_3 + 6A$

$6A = i_2 - i_3$

$6A = \frac{V_1 - V_2}{3} - \frac{(V_2 - 0)}{4}$

$72 = 4(V_1 - V_2) - 3V_2$

$72 = 4V_1 - 4V_2 - 3V_2$

$72 = 4V_1 - 7V_2$ ... (2)

At Node 3:

$6A + i_1 = i_3$

$6A = i_3 - i_1$

$6A = \frac{V_3 - 0}{6} - \frac{(V_1 - V_2)}{2}$

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$$384 = V_3 - \frac{3(V_1 - V_3)}{2}$$

$$384 = -3V_1 + 4V_3 \quad \text{--- (3)}$$

From Cramer's rule:

$$5V_1 - 2V_2 - 3V_3 = 60$$

$$4V_1 - 7V_2 = 768$$

$$-3V_1 + 0 + 4V_3 = 384$$

$$\begin{vmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ -3 & 0 & 4 \end{vmatrix} \begin{vmatrix} V_1 \\ V_2 \\ V_3 \end{vmatrix} = \begin{vmatrix} 60 \\ 768 \\ 384 \end{vmatrix}$$

$$V_1 = \frac{\Delta_1}{\Delta}, \quad V_2 = \frac{\Delta_2}{\Delta}, \quad V_3 = \frac{\Delta_3}{\Delta}$$

$$\Delta = \begin{vmatrix} 5 & -2 & -3 \\ 4 & -2 & 0 \\ -3 & 0 & 4 \end{vmatrix} = -45$$

$$\Delta_1 = \begin{vmatrix} 60 & -2 & -3 \\ 768 & -2 & 0 \\ 584 & 0 & 4 \end{vmatrix} = -3600$$

$$V_1 = \frac{\Delta_1}{\Delta} = \frac{-3600}{-45} = 80\Omega$$

$$\Delta_2 = \begin{vmatrix} 3 & 60 & -3 \\ 4 & 768 & 0 \\ -3 & 384 & 4 \end{vmatrix} = 2800$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{2800}{-45} = -62.4V$$

$$\Delta_3 = \begin{vmatrix} 5 & -2 & 60 \\ 4 & -7 & 768 \\ -3 & 0 & 384 \end{vmatrix} = -7020$$

$$V_3 = \frac{\Delta_3}{\Delta} = \frac{-7020}{-45} = 156V$$

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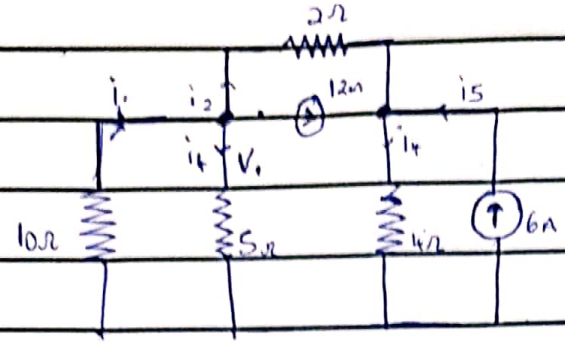
2.)



At Node 1:

KCL: $i_1 = i_2 + i_3 + i_4$

$$\frac{0 - V_1}{10} = \frac{V_1 - V_2}{2} + 12 + \frac{V_1 - 0}{5}$$

$$-V_1 - 5(V_1 - V_2) + 120 + 2V_1$$

$$120 = -8V_1 + 5V_2 \quad \text{---} (1)$$

At Node 2:

$$i_3 + i_2 + i_5 = i_6$$

$$12 + \frac{V_1 - V_2}{2} + 6 = \frac{V_2 - 0}{6}$$

$$96 + 4(V_1 - V_2) + 48 = 2V_2$$

$$144 = -4V_1 + 6V_2 \quad \text{---} (2)$$

Solve eqn. (1) & (2) Simultaneously

$$120 = -8V_1 + 5V_2$$

$$144 = -4V_1 + 6V_2$$

We get, $V_1 = 0$ & $V_2 = 24V$

$$i_2 = \frac{V_1 - V_2}{2} = \frac{24 - 0}{2} = 12A,$$

$$i_6 = \frac{V_2 - 0}{4} = \frac{24}{4} = 6A,$$

$$i_1 = \frac{0 - V_1}{10} = \frac{-0}{10} = 0A,$$

$$i_4 = \frac{V_1 - 0}{5} = \frac{0}{5} = 0A,$$

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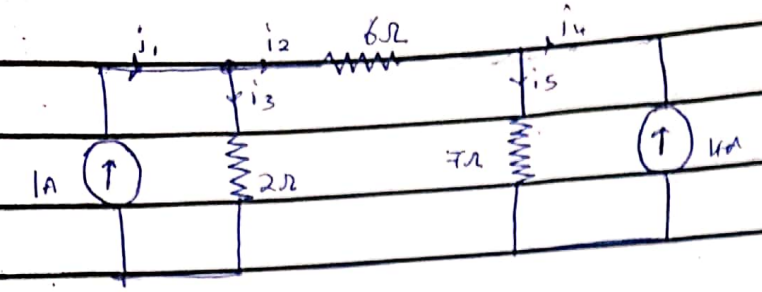

At node 1:

$i_1 = i_2 + i_3$

$1 = \frac{V_1 - V_2}{6} + \frac{V_1 - 0}{2}$

$6 = (V_1 - V_2) + 3V_1$

$6 = 4V_1 - V_2$ ---(i)

At Node 2:

$i_2 = i_4 + i_3$

$\frac{V_1 - V_2}{6} = 4 + \frac{V_2 - 0}{7}$

$7(V_1 - V_2) = 168 + 6V_2$

$168 = 7V_1 - 13V_2$ ---(ii)

Solve (i) & (ii) Simultaneously

$V_1 = -2V$ & $V_2 = -14V$

$i_2 = \frac{V_1 - V_2}{6} = \frac{-2 + 14}{6} = 2A$, $i_5 = V_2/5 = -14/7 = -2A$

$i_3 = V_1/2 = -2/2 = -1A$

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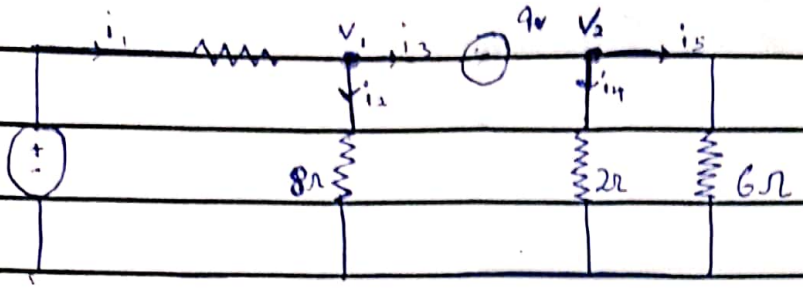
3.)



At Node 1

$i_1 + i_2 + i_3 + i_4 = 0$

$$\frac{V_1 - 21}{4} + \frac{V_1}{3} + \frac{V_2}{6} + \frac{V_2}{2} = 0$$

$$7V_1 + 8V_2 - 63 = 0 \quad \text{---(i)}$$

At Loop 1;

$$V_1 - V_2 = 9 \quad \text{---(ii)}$$

Solving (i) & (ii) Simultaneously

$V_1 = -0.6V$ & $V_2 = 8.4V$

$$i_1 = \frac{V_1 - 21}{4} = \frac{-0.6 - 21}{4} = -5.4A$$

$$i_2 = \frac{V_1}{3} = \frac{-0.6}{3} = -0.2A$$

$$i_4 = \frac{V_2}{2} = \frac{8.4}{2} = 4.2A$$

$$i_5 = \frac{V_2}{6} = \frac{8.4}{6} = 1.4A$$

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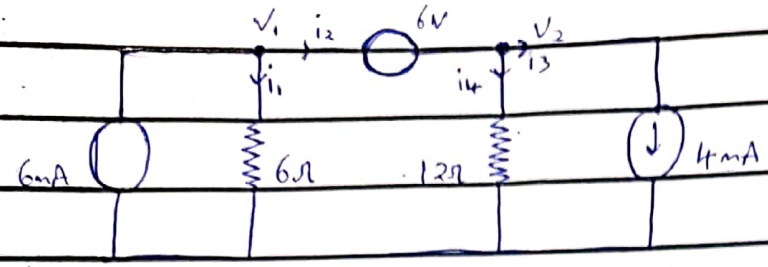
4.)



$V_1 - V_2 = 6V$ ---(i)

At node 1

$6mA = i_1 + i_2$

$6 \times 10^{-3} = V_1/6 + V_1 - V_2$

$36 \times 10^{-3} = V_1 + 6(V_1 - V_2)$

$36 \times 10^{-3} = 7V_1 - 6V_2$ ---(ii)

At Node 2

$i_2 = i_3 + i_4$

$V_1 - V_2 = V/12 + 4 \times 10^{-3}$

$12(V_1 - V_2) = V_2 + 48 \times 10^{-3}$

$48 \times 10^{-3} = 12V_1 - 13V_2$ ---(iii)

Solving Simultaneously

$V_1 = 0.0095V \simeq 9.5mV$ & $V_2 = 0.0051V \simeq 5.1mV$

$i_1 = \frac{V_1}{6} = \frac{9.5 \times 10^{-3}}{6} = 1.583 mA$

$i_4 = \frac{V_2}{12} = \frac{5.1 \times 10^{-3}}{12} = 0.425 mA$

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