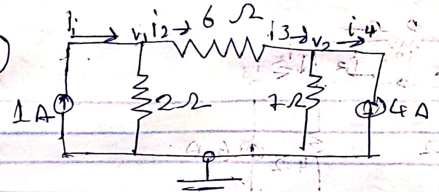
(3)



At Node 1

$i_1 = i_2 + i_3$

$1 = \frac{v_1 - v_2}{6} + \frac{v_1}{2}$

$6 = v_1 - v_2 + 3v_1$

$6 = 4v_1 - v_2 \dots (i)$

At Node 2

$i_2 = i_4 + i_5$

$\frac{v_1 - v_2}{6} = 4 + \frac{v_2}{7}$

$7(v_1 - v_2) = 168 + 6v_2$

$168 = 7v_1 - 13v_2 \dots (ii)$

from eqn (i), $v_2 = 4v_1 - 6$

Subs $v_2 = 4v_1 - 6$ in eqn (ii)

$168 = 7v_1 - 13(4v_1 - 6)$

$168 = 7v_1 - 52v_1 + 78$

$90 = -45v_1$

$v_1 = 90/-45$

$v_1 = -2V$

Subs ($v_1 = -2$) in eqn (i) $6 = 4(-2) - v_2$

$6 = -8 - v_2$

$v_2 = -8 - 6$

$v_2 = -14V$

$\therefore v_2 = -14V$

Current through the resistor

$i_2 = \frac{v_1 - v_2}{6} = \frac{-2+14}{6} = 2A$

$i_3 = \frac{v_1}{2} = \frac{-2}{2} = -1A$

$i_5 = \frac{v_2}{7} = \frac{-14}{7} = -2A$

iv) Matrix Representation

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

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

where $\Delta = \begin{vmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ -3 & 0 & 4 \end{vmatrix}$

$= 5(-28-0) + 2(16+0) - 3(0-21)$

$= -140 + 32 + 63$

$= -45$

$\Delta_1 = \begin{vmatrix} 60 & -2 & -3 \\ 768 & -7 & 0 \\ 384 & 0 & 4 \end{vmatrix}$

$= 60(-28-0) - 768(-8-0) + 384(0-21)$

$= -1680 + 6144 - 8064$

$= -3600$

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

for V_2: $\Delta_2 = \begin{vmatrix} 5 & 60 & -3 \\ 4 & 768 & 0 \\ -3 & 384 & 4 \end{vmatrix}$

$= 5(768 \times 4 - 0) - 4(60 \times 4) - (384 - 3) - 3(0 - 768 \cdot 4)$

$= 2880$

$V_2 = \frac{\Delta_2}{\Delta} = \frac{2880}{-45} = -64V$

for V_3: $= -7020$

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

$\therefore V_1 = 80V$, $V_2 = -64V$, $V_3 = 156V$

Scanned with CamScanner

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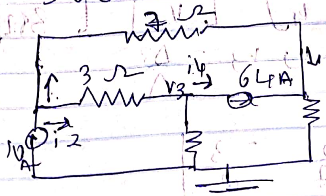
(1)



At node 1, KCL:

$10 = i_1 + i_2 \Rightarrow 10 = \frac{V_1 - V_2}{2} + \frac{V_1 - V_2}{3}$

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

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

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

At node 2, KCL:

$i_2 = i_3 + 64$

$64 = i_2 - i_3$

$64 = \frac{V_1 - V_2}{V_3} - \frac{V_2 - 0}{4}$

$768 = 4(V_1 - V_2) - 3(V_2 - 0)$

$768 = 4V_1 - 4V_2 - 3V_2$

$768 = 4V_1 - 7V_2$ ... (ii)

At node 3, KCL

$64 + i_1 = i_5$

$64 = i_5 - i_1$

$64 = \frac{V_3 - 0}{6} - \frac{V_1 - V_3}{2}$

$384 = V_3 - 3(V_1 - V_3)$

$384 = -3V_1 + 4V_3$ --- (iii)

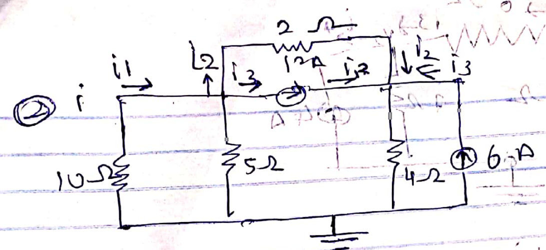
Using Cramer's Rule

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

$4V_1 - 7V_2 = 768$ --- (ii)

$-3V_1 + 4V_3 = 384$ --- (iii)

② i



At Node 1; KCL

$i_1 = i_2 + i_3 + i_4$

$\frac{V_0 - V_1}{10} = \frac{V_1 - V_2}{2} + 12 + \frac{V_1 - V_1}{5}$

$0 - V_1 = 5(V_1 - V_2) + 1250 + 2(V_1 - 10)$

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

$120 = -8V_1 + 5V_2$

At node 2

$i_3 + i_2 + i_5 = i_6$

$12 + \frac{V_1 - V_2}{2} + 6 = \frac{V_2 - 0}{4}$

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

$144 + 4V_1 - 4V_2 = 2V_2$

$144 = -4V_1 + 6V_2$ (ii)

using elemination method

$120 = -8V + 5V_2$ ...(i) $(\times 4)$

$144 = -4V_1 + 6V_2$ ...(ii) $(\times 8)$

$-480 = 32V_1 - 20V_2$ ...(iii)

$-1152 = 32V_1 - 48V_2$ ...(iv)

Subtract eqn (iv) from (iii)

$-672 = 0 - 28V_2$

$V = \frac{-672}{-28}$

$V_2 = 24V$

Subs. $V_2 = 24$ in eqn (ii)

$144 = -4V + 6V_2$

$V_1 = \frac{144 - 6V_2}{-4}$

$V = 0$ $V_1 = 0V$, $V_2 = 24V$