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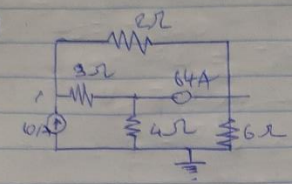
Computer Engineering
17/ENG02/7032
EEE 322 Assignment

(1)



find the Voltages at Node 1, 2, and 3

From Node 1, Applying KCL

$10 = I_1 + I_2 = 10 = \left(\frac{V_1 - V_3}{2}\right) + \left(\frac{V_1 - V_2}{3}\right)$

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

$10 = \frac{3(V_1 - V_3) + 2(V_1 - V_2)}{6}$

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

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

$60 = 5V_1 - 2V_2 - 3V_3$ —— eqn①

Then from Node 2, (KCL)

$I_2 = I_3 + 64A$

$64 = I_2 - I_3$ (Since $I_2 = \frac{V_1 - V_2}{3}$ & $I_3 = \frac{V_2 - 0}{4}$)

$64 = \left(\frac{V_1 - V_2}{3}\right) - \left(\frac{V_2 - 0}{4}\right)$

$64 = \frac{4(V_1 - V_2) - 3(V_2 - 0)}{12}$

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

$768 = 4V_1 - 7V_2$ —— eqn②

Node 3

$64 + I_1 = I_5$

$64 = I_5 - I_6$

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

$64 = \frac{V_3 - 0 - 3(V_1 - V_3)}{6}$

$384 = V_3 - 3V_1 + 3V_3$

$384 = -3V_1 + 4V_3$ ——— (3)

Applying Cramer's Rule

$5V_1 - 2V_2 - 3V_3 = 60$ — (i)

$4V_1 - 7V_2 + 0 = 768$ — (ii)

$-3V_1 + 0 + 4V_3 = 384$ — (iii)

Matrix form

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

$V_1 = \Delta_1/\Delta$, $V_2 = \Delta_2/\Delta$, $V_3 = \Delta_3/\Delta$

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

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

$\Delta = -140 + 32 + 63$

$\Delta = -45$

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

$\Delta_1 = 60(-28) + 768(-8) + 384(-21)$

$\Delta_1 = -1680 + 6144 - 8064$

$= -3600$

$\therefore V_1 = \Delta_1/\Delta = -3600/-45 = 80$ V

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

$= 5(3072) - 4(240 + 1152) - 3(+2304)$

$= 15360 - 5760 - 6912$

$= 2880$

$V_2 = \Delta_2/\Delta = -64$ V

For V_3:

+	5	-2	60
-	4	-7	768
+	-3	0	384

$= 5(-288) - 4(-768) - 3(-1536 + 420)$

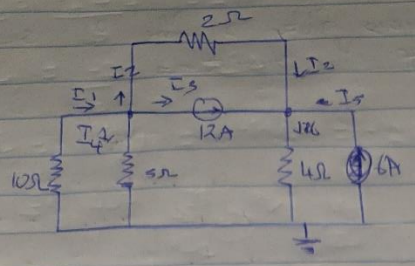
$\Delta_3 = -7020$

$V_3 = \Delta_3 / \Delta = -7020 / -45 = 156V$

$\therefore$ ~~$V_1 = 80V$, $V_2 = -220V$, $V_3 = 156V$~~

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

(2.1)



(1) $I_1 = I_2 + I_3 + I_4$

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

$$0 - V_1 = 5(V_1 - V_2) + 120 + 2(V_1 - 0)$$

$$-V_1 = 5V_1 - 5V_2 + 120 + 2V_1$$

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

Node 2 $(I_3 + I_2 + I_5 = I_6)$

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

$$24 + V_1 + V_2 + 12 = V_2 - 0$$

$$36 + V_1 + V_2 = \frac{V_2 - 0}{2}$$

$$72 + 2V_1 + 2V_2 = V_2 \quad (i)$$

$$72 + 2V_1 = V_2 - 2V_2$$

$$72 = 2V_1 - V_2$$

$$18 + \frac{V_1 - V_2}{2} = \frac{V_2 - 0}{4}$$

$$\frac{V_1 - V_2}{2} = \frac{V_2}{4} - 18$$

$$\frac{V_1 - V_2}{2} - \frac{V_2}{4} = -18$$

$$\frac{2(V_1 - V_2) - V_2}{4} = -18$$

$$2V_1 - 2V_2 - V_2 = -72$$

$$2V_1 - 3V_2 = -72 \quad \text{---} (ii)$$

Using elimination method

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

$$-72 = 2V_1 - 3V_2 \quad \text{---} (i) \times 4$$

$120 = -8V_1 + 5V_2$

$-288 =$

$288 = -8V_1 + 12V_2$ — (×5)

$120 = -8V_1 + 5V_2$ — (×12) — (i)

$168 = 0 + 7V_2$

$V_2 = 24V$

put V_2 into eqn (i)

$120 = -8V_1 + 5(24)$

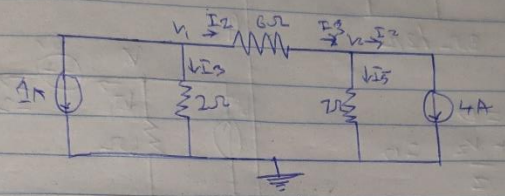
$120 = -8V_1 + 120$

$V_1 = 0$

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

$I_1 = 0A, \quad I_2 = 0A, \quad I_3 = 6A, \quad I_4 = 12A$

(ii)



Node 1

$I_1 = I_2 + I_3$

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

$\frac{1}{1} = \frac{V_1 - V_2 + 3V_2}{6}$

$6 = 4V_1 - V_2$ — (i)

Node 2

$I_2 = I_4 + I_5$

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

$\frac{7(V_1 - V_2) - 6V_2}{42} = 4$

$168 = 7V_1 - 13V_2$ — (ii)

↓

$\times$ eqn by $+13 = (78 = +52V_1 - 13V_2)$ — (iii)

$\therefore$ subtract eqn (i) from 3

$78 = 52V_1 - 13V_2$

$168 = 7V_1 - 13V_2$

$-90 = 45V_1 + 0$

$V_1 = -2V$

put $V_1 = -2V$ into eqn (ii)

→ $168 = 7(-2) - 13V_2$

$168 = -14 - 13V_2$

$182 = -13V_2$

$V_2 = -14V$ eg

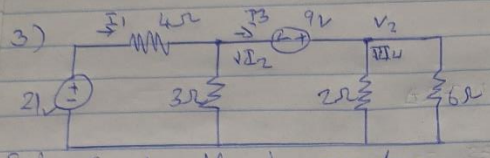
Current through resistors

$I_2 = \frac{-2+14}{6} = 2A$

$I_3 = \frac{-2}{2} = -1A$

$I_5 = V_2/2 = -14/2 = -2A$

3)



find Current through 3Ω /2Ω

Applying KL

$I_1 + I_2 + I_3 + I_4 = 0$

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

$7V_1 + 8V_2 = 63$ ——(i)

KVL For Loop 1

$-V_1 - 9 + V_2 = 0$

$-V_1 + V_2 = 9$ —(ii)

Simultaneously

$\therefore 7V_1 + 8V_2 = 63$ —(i)

$-V_1 + V_2 = 9$ —(ii)

From eqn 2

$V_2 = 9 + V_1$ ——(*)

put eqn (*) in (i)

$7V_1 + 8(9 + V_1) = 63$

$7V_1 + 72 + 8V_1 = 63$

$15V_1 = -9$

$V_1 = -0.6V$

put $V_1 = -0.6V$ in eqn (*)

$V_2 = 9 - 0.6V$

$V_2 = 8.4V$

$\therefore V_1 = -0.6V$

$V_2 = 8.4V$

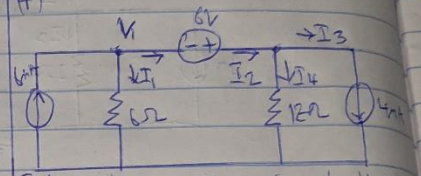
Current through 3Ω resistor

$I_2 = \frac{V_1}{3} = \frac{-0.6}{3} = -0.2A$

Current through the 2Ω resistor

$I_4 = \frac{V_2}{4} = \frac{8.4}{4} = 2.1V_{4}$

4)



find voltage and Current through the 12Ω and 6Ω resistor

Sol

At Node 1: KCL

$6mA = I_1 + I_2$

$6 = \frac{V_1}{6} + (V_1 - V_2)$

$36 = V_1 + 6(V_1 - V_2)$

$36 = 7V_1 - 6V_2$ —(i)

Node 2

$I_2 = I_3 + I_4$

$V_1 - V_2 = 4mA + \frac{V_2}{12}$

$12(V_1 - V_2) = 48 + V_2$

$12V_1 - 12V_2 = 48 + V_2$

$12V_1 - 13V_2 = 48$ —(ii)

4) Solving

Current

Current

4) Solving V_1 and V_2

$V_1 = 9.5$, $V_2 = 5.1V$

Current through 6Ω resistor

$I_1 = \frac{V_1}{6} = \frac{9.5}{6} = 1.58A$, $I_2 = V_1 - V_2 = 9.5 - 5.1 = 4.4A$

Current through 12 resistor

$I_4 = \frac{V_2}{12} = \frac{5.1}{12} = 0.43A$

$\therefore V_1 = 9.5V$, $V_2 = 5.1V$

$I_1 = 1.58A$, $I_4 = 0.43A$

resistor

0.2A

2 resistor

2.1V

I3

4mA

through

r

D