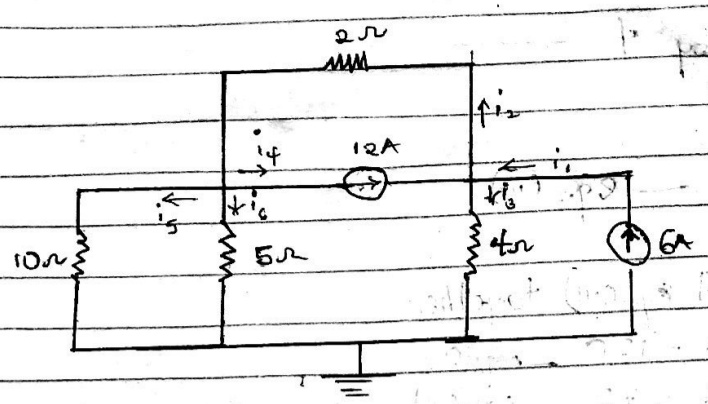
Name: ALEGBELEYE OLUWAFEMI OLADIPUPO
Matric No: 17/ENG04/011
Department: ELECT/ELECT

EEE322 ASSIGNMENT SOLUTION



Applying KCL to node 1

$i_5 + i_6 + i_4 = i_2$ — eqn (i)

$i_5 = \frac{V_2 - 0}{10}$ $\quad i_4 = 12$

$i_6 = \frac{V_2 - 0}{5}$ $\quad i_2 = \frac{V_1 - V_2}{2}$

Substituting into eqn (i)

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

multiply all through by 10

$V_2 + 2V_2 + 120 = 5V_1 - 5V_2$ <collecting like terms>

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

$= 8V_2 - 5V_1 = -120$

reversing equation:

$= 5V_1 - 8V_2 = 120$ — eqn (ii)

Applying KCL at node 2.

$i_1 + i_4 = i_2 + i_3$

$i_1 = 6A$ $\quad i_4 = 12A$

$i_2 = \frac{V_1 - V_2}{2}$ $\quad i_3 = \frac{V_1 - 0}{4}$

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

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

multiply all through by 4

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

Collecting like terms

$$72 = 3V_1 - 2V_2 \quad \text{— eqn (iii)}$$

Putting eqn(ii) and eqn(iii) together

$$5V_1 - 8V_2 = 120 \quad \text{— eqn(ii)}$$
$$3V_1 - 2V_2 = 72. \quad \text{— eqn(iii)}$$

Using Elimination method:

eqn(iii) is multiplied by 4

$$5V_1 - 8V_2 = 120 \quad \text{— eqn(iv)}$$
$$12V_1 - 8V_2 = 288 \quad \text{— eqn(v)}$$

Subtract eqn(iv) from eqn(v)

$$-7V_1 = -168$$

$$V_1 = 24V$$

Substituting $V_1 = 24V$ into eqn(iv)

$$5(24) - 8V_2 = 120$$
$$120 - 8V_2 = 120$$
$$-8V_2 = 0$$
$$V_2 = 0$$

∴ Current flowing

$i_1 = 6A$

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

$i_3 = \frac{24-0}{4} = 6A$

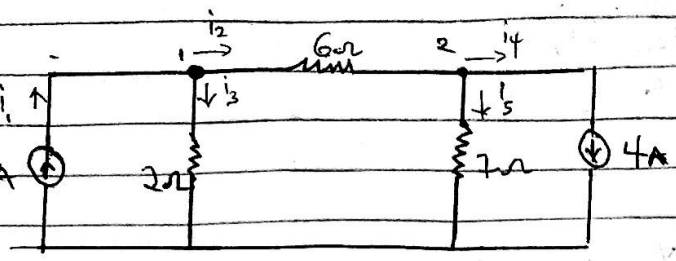
$i_4 = 12A$

$i_5 = \frac{0}{10} = 0A$

$i_6 = \frac{0}{5} = 0A$

$i_1, i_2, i_3, i_4, i_5, i_6$ are 6A, 12A, 6A, 12A, 0, 0 respectively

ii



Applying Kcl at node 1

$i_1 = i_2 + i_3$ $\quad i_1 = 1A$ $\quad i_2 = \frac{V_1 - V_2}{6}$ $\quad i_3 = \frac{V_1 - 0}{2}$

Substituting

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

multiply all through by 6

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

$$6 = 4V_1 - V_2 \quad \text{— eqn a)}$$

at node 2

$i_2 = i_4 + i_5$; $\quad i_2 = \frac{V_1 - V_2}{6}$ $\quad i_4 = 4A$ $\quad i_5 = \frac{V_2 - 0}{7}$

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

multiply all through by 42

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

collecting like terms

$$7V_1 - 13V_2 = 168 \quad \text{— eqn (ii)}$$

bringing eqn (i) and eqn (ii) together.

$$4V_1 - V_2 = 6 \quad \text{— eq (i)}$$

$$7V_1 - 13V_2 = 168 \quad \text{— eqn (ii)}$$

multiplying - eqn by 13

$$52V_1 - 13V_2 = 78 \quad \text{— eqn (iii)}$$

$$7V_1 - 13V_2 = 168 \quad \text{— eqn (iv)}$$

Subtracting eqn (iii) from eqn (iv)

$$45V_1 = -90$$

$$V_1 = -2V$$

Substituting V_1 into eqn (1)

$4(-2) - V_2 = 6$

$-8 - V_2 = 6$

$-V_2 = 14$

$V_2 = -14V$

to determine currents

$i_1 = 1A$

$i_2 = \frac{12-(-14)}{6} = \frac{-2-(-14)}{2} = \frac{12}{6} = 2A$

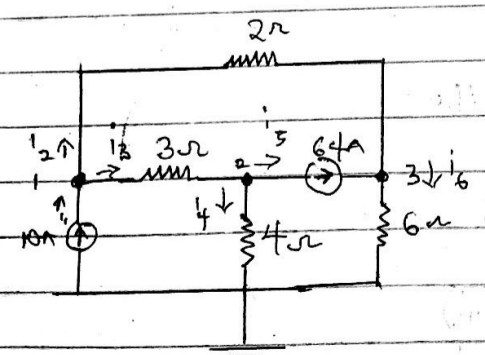
$i_3 = \frac{-2}{2} = -1A$

$i_4 = 4A$

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

The currents are 1A, 2A, -1A, 4A, -2 are i_1, i_2, i_3, i_4, i_5 respectively.

2.



Applying KCL at node 1

$i_1 = i_2 + i_3$; $i_1 = 10A$, $i_2 = \frac{V_1 - V_3}{2}$ $i_3 = \frac{V_1 - V_2}{3}$

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

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

$60 = 5V_1 - 2V_2 - 3V_3$ — eqn (1)

at node 2

$i_3 = i_4 + i_5$

$$\frac{V_1 - V_2}{3} = \frac{V_2 - 0}{4} + 64$$

$$\frac{V_1 - V_2}{3} = \frac{V_2}{4} + 64$$

multiply all through by 12

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

$$4V_1 - 7V_2 = 768 \quad \text{— eqn (ii)}$$

at node 3

$i_1 = i_2 + i_5 = i_6$

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

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

multiply by 6

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

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

reversing equation

$$4V_3 - 3V_1 = 384 \quad \text{— eqn (iii)}$$

$$5V_1 - 2V_2 - 3V_3 = 60$$
$$4V_1 - 7V_2 = 768$$
$$-3V_1 + 4V_3 = 384$$

Using matrix rule

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

Using calculator:

$\Delta = -45$

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

$$= 60(-28) + 2(3072) - 3(2688)$$

$$\Delta_1 = -3600$$

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

$$V_1 = 80V$$

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

$$= 5(3072) - 60(16) - 3(3840)$$

$$\Delta_2 = 2880$$

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

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

$$= 5(-2688) + 2(3840) - 60(-21)$$

$$\Delta_3 = -7020$$

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

$$= 156V$$

Voltage at each node 1, 2, 3

$V_1 = 80V$

$V_2 = -64V$

$V_3 = 156V$