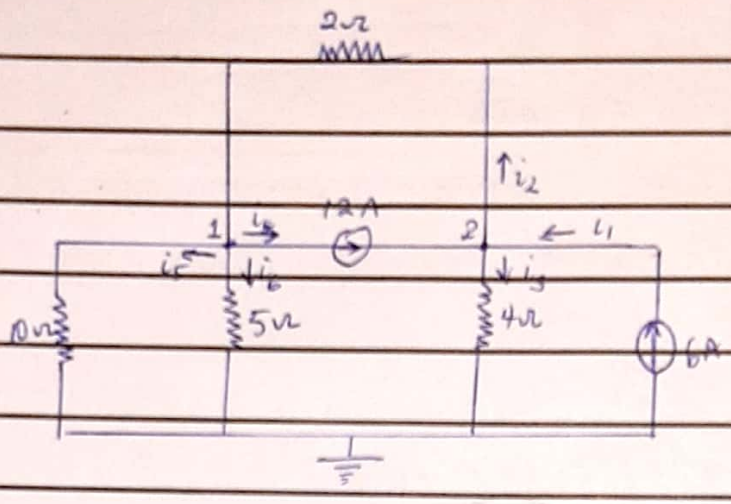
NWAGWAGWU TOCHUKWU DAISY 11/05/2020

17/ENG04/043 ELECT ELECT

EEE 322 ASSIGNMENT

(1) i)



Applying KCL to node 1

$i_5 + i_6 + i_4 = i_2$ $\quad i_4 = 12$

$i_5 = \frac{V_2 - 0}{10}$

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

Substituting to Equation 1

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

eliminating the fractions multiplying through by 10

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

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

$8V_2 - 5V_1 = -120$

$5V_1 - 8V_2 = 120$ ——— (1)

Applying KCL to node 2

$i_1 + i_4 = i_2 + i_3$

$i_1 = 6A$

$i_4 = 12A$

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

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

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

multiplying through by 4

$72 = 2V_1 - 2V_2 + V_1$

$72 = 3V_1 - 2V_2$

$3V_1 - 2V_2 = 72$ ——— (II)

Solving eqn (I) nd (II) simultaneously

$5V_1 - 8V_2 = 120$ — (I)

$3V_1 - 2V_2 = 72$ — (II)

Using elimination method

multiply (II) by 4

$5V_1 - 8V_2 = 120$ — (III)

$12V_1 - 8V_2 = 288$ — (IV)

Subtract (III) from (IV)

$-7V_1 = -168$

$V_1 = 24V$

Substituting V_1 in eqn III

$5(24) - 8V_2 = 120$

$120 - 8V_2 = 120$

$8V_2 = 0$

$V_2 = 0$

∴ Currents flowing

$i_1 = 6A$

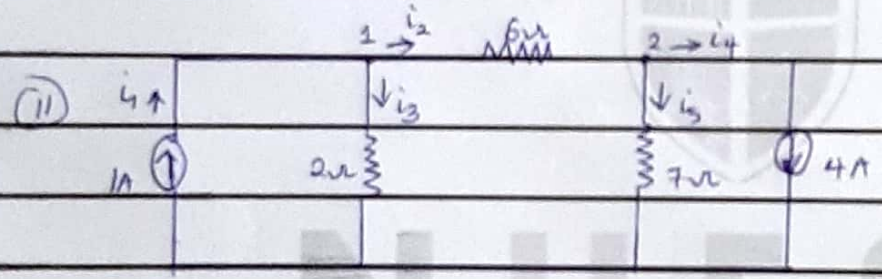
$i_2 = \frac{V_1 - V_2}{2} = \frac{24 - 0}{2} = 12A$

$i_3 = \frac{V_1 - 0}{4} = \frac{24}{4} = 6A$

$i_4 = 12A$

$i_5 = \frac{V_2 - 0}{10} = \frac{0 - 0}{10} = 0A$

$i_6 = \frac{V_2 - 0}{5} = \frac{0 - 0}{5} = 0A$



Applying KCL at node 1

$i_1 = i_2 + i_3$ $\quad i_1 = 1A$

$i_2 = \frac{V_1 - V_2}{6}$ $\quad i_3 = \frac{V_1 - 0}{2}$

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

multiplying through by 6

$6 = V_1 - V_2 + 3V_1$ —— (11)

$4V_1 - V_2 = 6$ —— (11)

Applying KCL at node 2

$i_2 = i_4 + i_5$

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

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

multiplying through by 42

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

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

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

solving (I) and (II) simultaneously

$$4V_1 - V_2 = 6 \quad \text{— (I)}$$

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

from (I)

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

$$7V_1 - 13(4V_1 - 6) = 168$$

$$7V_1 - 52V_1 + 78 = 168$$

$$-45V_1 = 90$$

$$V_1 = \frac{90}{-45} = -2V$$

Putting V_1 in (III)

$$4(-2) - 6 = V_2$$

$$V_2 = -8 - 6 = -14V$$

∴ The currents flowing

$$i_1 = \frac{1A}{=}$$

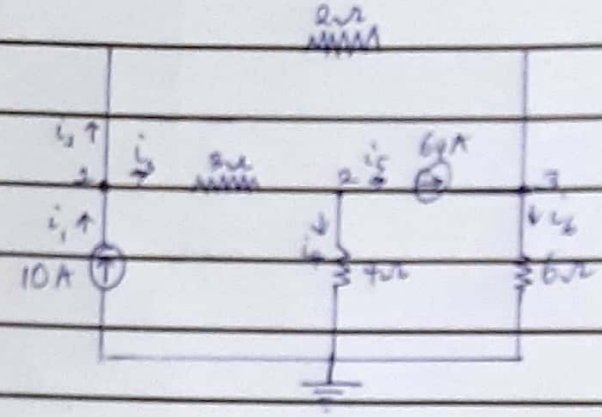
$$i_6 = \frac{V_1 - V_2}{6} = \frac{-2 - -14}{6} = \frac{12}{6} = 2A$$

$$i_2 = \frac{V_1}{2} = \frac{-2}{2} = -1A$$

$$i_4 = \frac{4A}{=}$$

$$i_5 = \frac{V_2}{7} = \frac{-14}{7} = -2A$$

2)



Applying KCL at node 1

$i_1 = i_2 + i_3$

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

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

multiplying through by 6

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

$$60 = 5V_1 - 2V_2 - 3V_3 \quad \text{——} \quad (1)$$

at node 2

$i_3 = i_4 + i_5$

$i_5 = 64A$ $\quad i_3 = \frac{V_1 - V_2}{3}$ $\quad i_4 = \frac{V_2 - 0}{4}$

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

multiplying through by 12

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

$$4V_1 - 7V_2 = 768 \quad \text{——} \quad (11)$$

at node 3

$i_6 = i_2 + i_5$

$i_5 = 64A$

$i_2 = \frac{V_1 - V_3}{2}$ $\quad i_4 = \frac{V_3 - 0}{6}$

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

multiplying through by 6

$V_3 = 3V_1 - 3V_3 + 384$

$3V_1 - 4V_3 = -384$

$4V_3 - 3V_1 = 384$ ——(iii)

solving eqn (i) (ii) and (iii) simultaneously

$5V_1 - 2V_2 - 3V_3 = 60$ ——(i)

$4V_1 - 7V_2 = 768$ ——(ii)

$-3V_1 + 4V_3 = 384$ ——(iii)

Using Matrix Rule

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

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

$= -45$

$$\Delta_1 = \begin{bmatrix} 60 & -2 & -3 \\ 760 & 7 & 0 \\ 384 & 0 & 4 \end{bmatrix}$$

$= 60(-28) + 2(30+2) - 3(2688)$

$\Delta_1 = -3600$

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

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

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

$$\Delta_2 = 2880$$

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

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

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

$$\Delta_3 = -7020$$

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

$V_1 = 80\,V$

$V_2 = -64\,V$

$V_3 = 156\,V$