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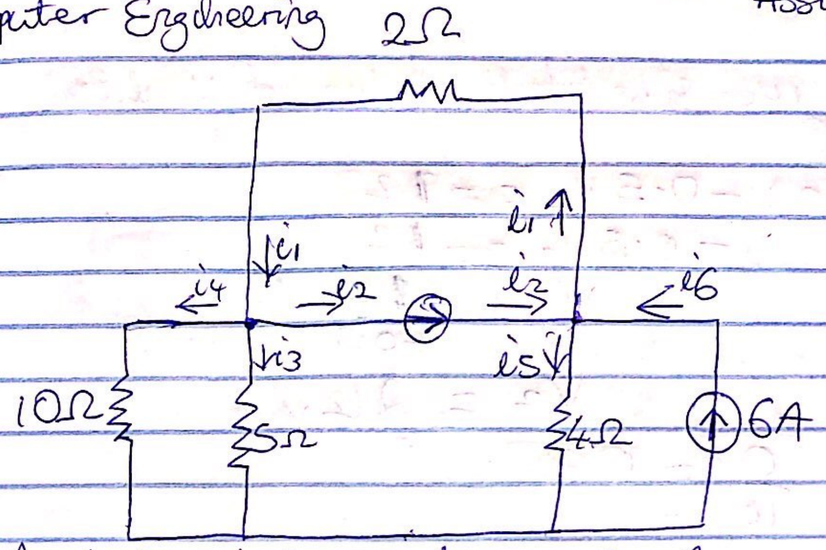
17/ENG02/045
Computer Engineering

EEE 322
Assignment

1i.)



Applying KCL to node 1

~~$i_1 + i_2 + i_3 + i_4 = 0$~~

$$i_1 = i_2 + i_3 + i_4$$

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

$$\left(\frac{V_1}{5} + \frac{V_1}{10} + \frac{V_1}{2}\right) - \frac{V_2}{2} = -12$$

$$\left(\frac{1}{5} + \frac{1}{10} + \frac{1}{2}\right)V_1 - \left(\frac{1}{2}\right)V_2 = -12$$

$$0.8\,V_1 - 0.5\,V_2 = -12 \quad \text{eqn } 1$$

Applying KCL to node 2

$$i_2 + i_6 = i_1 + i_5$$

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

$$18 = \left(\frac{-1}{2}\right)V_1 + \left(\frac{1}{4} + \frac{1}{2}\right)V_2$$

$$-0.5\,V_1 + 0.75\,V_2 = 18 \quad \text{eqn } 2$$

Solving eqn 1 & 2 simultaneously by elimination method

$$0.8V_1 - 0.5V_2 = -12 \times 6$$

$$-0.5V_1 + 0.75V_2 = 18 \times 4$$

$$\cancel{0.8}\ 4.8\,V_1 - 3 = -72$$

$$-\quad 2V_1 + 3 = 72$$

$$-2V_1 = 0$$

$$V_1 = 0$$

for V_2 we substitute value of V_1 into eqn ①

$\therefore 0.8(0) - 0.5V_2 = -12$

$-0.5V_2 = -12$

$V_2 = \frac{-12}{-0.5}$

$V_2 = 24V$

$i_4 = \frac{V_1}{10} = \frac{0}{10} = 0$

$i_2 = 12$

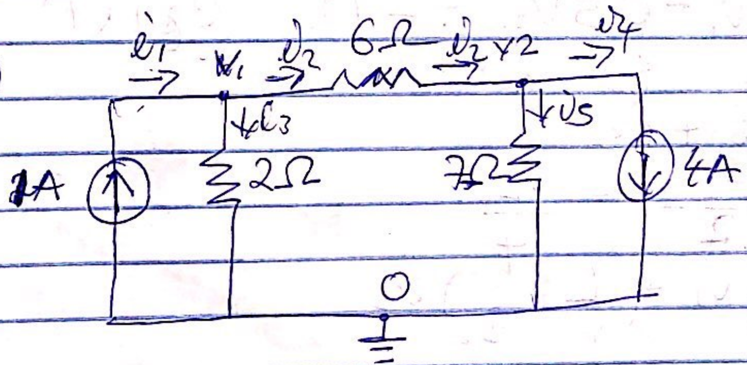
$i_3 = \frac{V_1}{5} = \frac{0}{5} = 0$

$\cancel{i_4 =}\ i_1 = \frac{V_1 - V_2}{2} = \frac{0-24}{2} = -12A$

$i_5 = \frac{V_2}{4} = \frac{24}{4} = 6A$

$i_6 = 6A$

ii.)



Applying KCL to node 1

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

$6 = V_1 - V_2 + 3V_1$

$6 = 4V_1 - V_2$ —— eqn ①

Applying KCL to node 2

$i_2 = i_4 + i_5$

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

$$7V_1 - 7V_2 = 168 + 6V_2$$
$$7V_1 - 13V_2 = 168 \text{ ——— eqn (2)}$$

from eqn (1) $V_2 = 4V_1 - 6$

Substitute $V_2 = 4V_1 - 6$ for V_2 in eq (2)

$$7V_1 - 13(4V_1 - 6) = 168$$
$$7V_1 - 52V_1 + 78 = 168$$
$$-45V_1 = = 90$$
$$V_1 = -2\,V$$

for V_2, Substitute $V_1 = -2$ into eqn (1)

$$V_2 = 4(-2) - 6$$
$$V_2 = -8 - 6$$
$$V_2 = -14\,V$$

$i_1 = 1A$

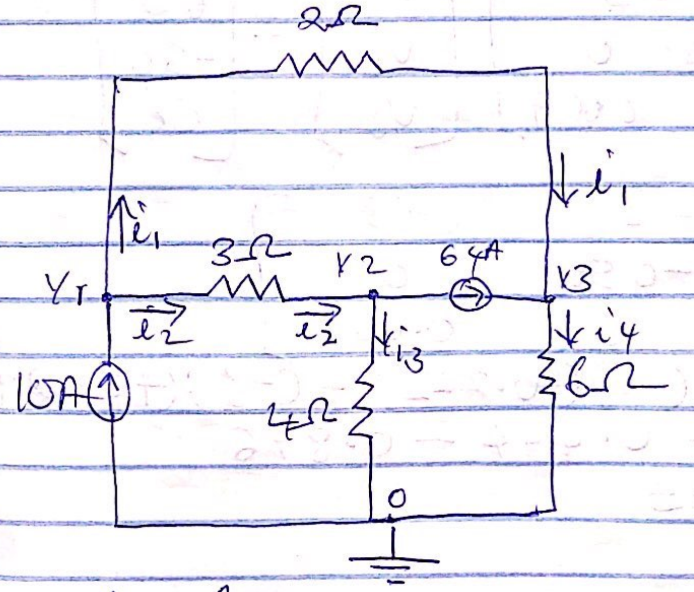
$i_2 = \frac{V_1 - V_2}{6} = \frac{-2-(-14)}{6} = \frac{12}{6} = 2A$

$i_3 = \frac{V_1}{2} = \frac{-2}{2} = -1A$

$i_4 = 4A$

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

2.)



at node 1

$$-10 + i_1 + i_2 = 0$$

$$-10 + \frac{V_1 - V_3}{2} + \frac{V_1 - V_2}{3} = 0$$

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

Applydy KCL at node 2

$$i_3 + 64 + \frac{V_2 - V_1}{3} = 0$$

$$i_3 + 64 + i_2 = 0$$

$$\cancel{i_3 +} \frac{V_2}{4} + \frac{V_2 - V_1}{3} = -64$$

$$\left(\frac{1}{4} + \frac{1}{3}\right) V_2 - \frac{1}{3} V_1 = -64 \text{ — eqn (2)}$$

Applying KCL to node 3

$$i_4 + i_3 - 64 = 0$$

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

$$\left(\frac{1}{6} + \frac{1}{2}\right) V_3 - \frac{1}{2} V_1 = 64 \text{ —— eqn (3)}$$

Using Cramer's rule

~~we~~ set the augmented matrix

$$\begin{array}{ccc} V_1 & V_2 & \\ \end{array}$$

$$\begin{bmatrix} 5 & -2 & -3 \\ -0.333 & -0.583 & 0 \\ -0.5 & 0 & 0.667 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 60 \\ -64 \\ 64 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} 5 & -2 & -3 \\ -0.333 & -0.583 & 0 \\ -0.5 & 0 & 0.667 \end{bmatrix}$$

$$= 5(0.389) - (-2)(-0.222) + (-3)(+0.292)$$

$$= 1.945 - 0.444 - 0.876$$

$$\Delta = 0.625$$

$$\Delta_1 = \begin{bmatrix} 60 & -2 & -3 \\ -64 & 0.583 & 0 \\ 64 & 0 & 0.667 \end{bmatrix}$$

$$= 60(0.389) - (-2)(-42.688) + (-3)(0 - 37.31$$

$$= 23.34 - 85.376 + 111.936$$

$$= 49.9 \simeq 50$$

$$\Delta_2 = \begin{bmatrix} 5 & 60 & -3 \\ -0.333 & -64 & 0 \\ -0.5 & 64 & 0.667 \end{bmatrix}$$

$$= 5(-42.688) - 60(-0.222) + (-3(-21.312 - 32))$$

$$= -213.44 + 13.32 + \cancel{32} + 159.94$$

$$= -40.18$$

$$V_1 = \frac{\Delta_1}{\Delta} = \frac{50}{0.625} = 80\,V$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{-40.18}{0.625} = -64.3 \simeq -64$$

V_3 for V_3 substitute V_1 & V_2 into eqn ①

②
$$5(80) - 2(-64) - 3V_3 = 60$$
$$400 + 128 - 60 = 3V_3$$
$$468 = 3V_3$$
$$V_3 = \frac{468}{3}$$
$$V_3 = 156\,V$$

③