BLM1612 - Circuit Theory

Examples

Example 12

- Determine the nodal voltages for the circuit.

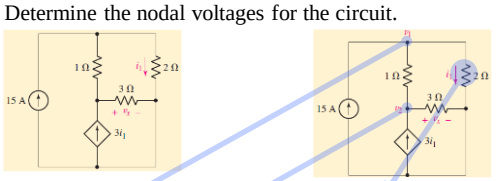
$$-8-3=\frac{v_1-v_2}{3}+\frac{v_1-v_3}{4}$$
$$0.5833v_1-0.3333v_2-0.25v_3=-11$$
$$-(-3)=\frac{v_2-v_1}{3}+\frac{v_2}{1}+\frac{v_2-v_3}{7}$$
$$-0.3333v_1+1.4762v_2-0.1429v_3=3$$
$$-(-25)=\frac{v_3}{5}+\frac{v_3-v_2}{7}+\frac{v_3-v_1}{4}$$
$$-0.25v_1-0.1429v_2+0.5929v_3=25$$

$$\begin{bmatrix}0.5833 & -0.3333 & -0.25\\ -0.3333 & 1.4762 & -0.1429\\ -0.25 & -0.1429 & 0.5929\end{bmatrix}\begin{bmatrix}v_1\\v_2\\v_3\end{bmatrix}=\begin{bmatrix}-11\\3\\25\end{bmatrix}$$

$v_1 = 5.412$ V $\quad v_2 = 7.736$ V $\quad v_3 = 46.32$ V

Example 13

- Determine the nodal voltages for the circuit.



$$15=\frac{v_1-v_2}{1}+\frac{v_1}{2}$$
$$3v_1-2v_2=30$$
$$3i_1=\frac{v_2-v_1}{1}+\frac{v_2}{3}$$
$$-15v_1+8v_2=0$$

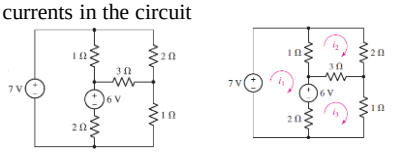
$$3v_1-2v_2=30$$
$$-15v_1+8v_2=0$$
$$v_1=-40\text{ V}\quad v_2=-75\text{ V}$$

$$i_1=\frac{v_1}{2}$$
$$i_1=0.5v_1=-20\text{ A}$$

- Power absorbed by the dependent source
$$(3i_1)(v_2)=-(-60)(-75)=-4.5\text{ kW}$$
- Actually 4.5 kW is supplied

Example 14

- Use mesh analysis to determine the three mesh currents in the circuit

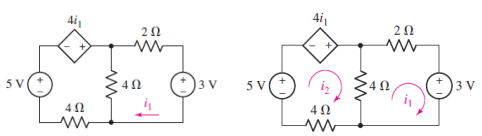


- Mesh 1 $-7+1(i_1-i_2)+6+2(i_1-i_3)=0$
- Mesh 2 $1(i_2-i_1)+2i_2+3(i_2-i_3)=0$
- Mesh 2 $2(i_3-i_1)-6+3(i_3-i_2)+1i_3=0$

$i_1 = 3$ A, $i_2 = 2$ A, and $i_3 = 3$ A.

Example 15

- Determine the current i_1 in the circuit

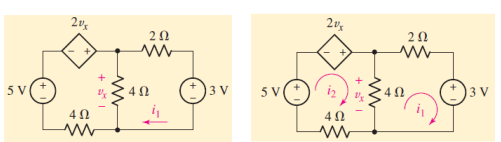


- Left Mesh $-5-4i_1+4(i_2-i_1)+4i_2=0$
- Right Mesh $4(i_1-i_2)+2i_1+3=0$

$i_2 = 375$ mA, so $i_1 = -250$ mA

Example 16

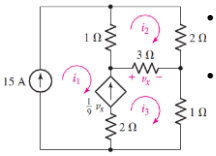
- Determine the current i_1 in the circuit



- Left Mesh $-5-2v_x+4(i_2-i_1)+4i_2=0$
- Right Mesh $4(i_1-i_2)+2i_1+3=0$

$v_x=4(i_2-i_1)\qquad 4i_1=5\qquad i_1=1.25$ A

Example 17



- Find the three unknown currents in the circuit
- Mesh 1 $i_1 = 15$ A
  - Since one of the two mesh currents relevant to the dependent current source is known, there is no need to write a supermesh equation about meshes 1 and 3

$$\frac{v_x}{9} = i_3 - i_1 = \frac{3(i_3 - i_2)}{9} \qquad -i_1 + \frac{1}{3}i_2 + \frac{2}{3}i_3 = 0 \quad \text{or} \quad \frac{1}{3}i_2 + \frac{2}{3}i_3 = 15$$

- Mesh 2 $1(i_2 - i_1) + 2i_2 + 3(i_2 - i_3) = 0$ $\qquad 6i_2 - 3i_3 = 15$

$i_1 = 15$ A $\qquad i_2 = 11$ $\qquad i_3 = 17$ A

7