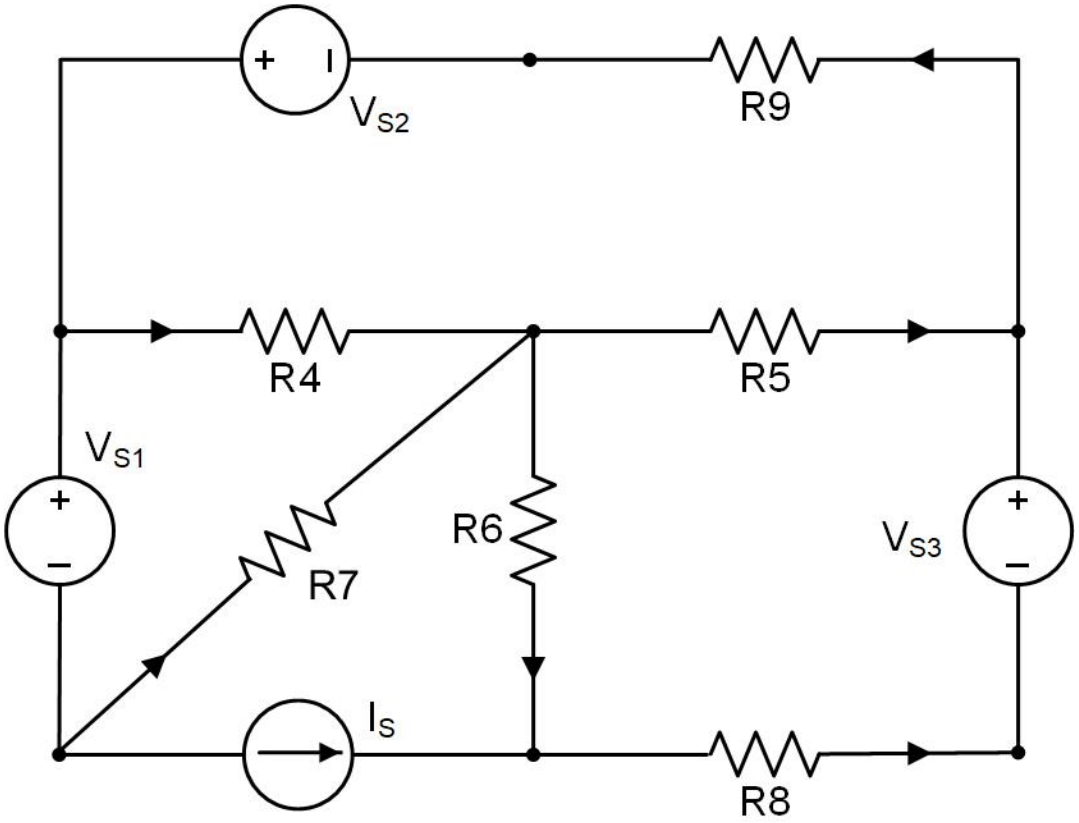
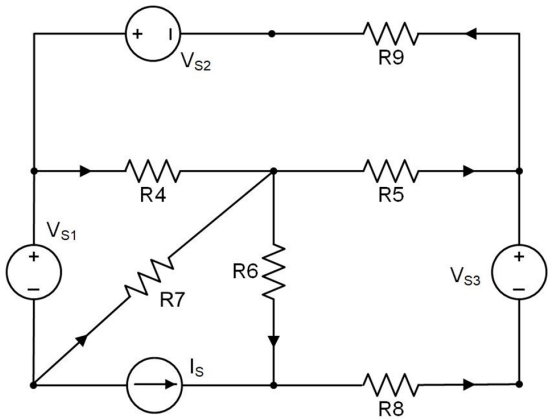
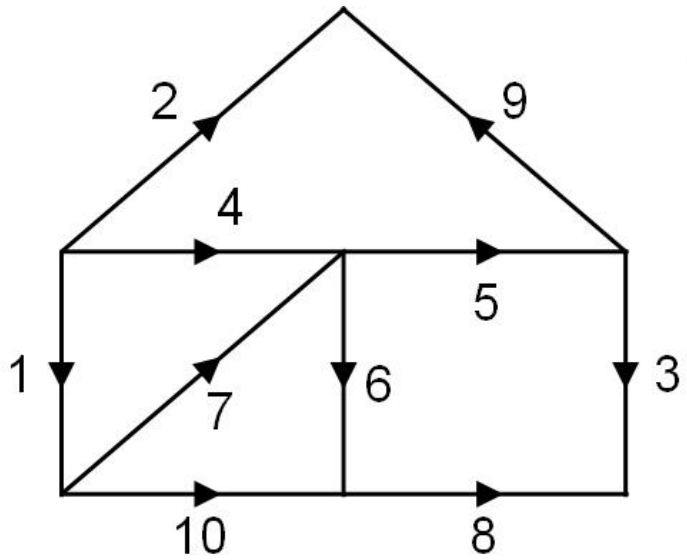
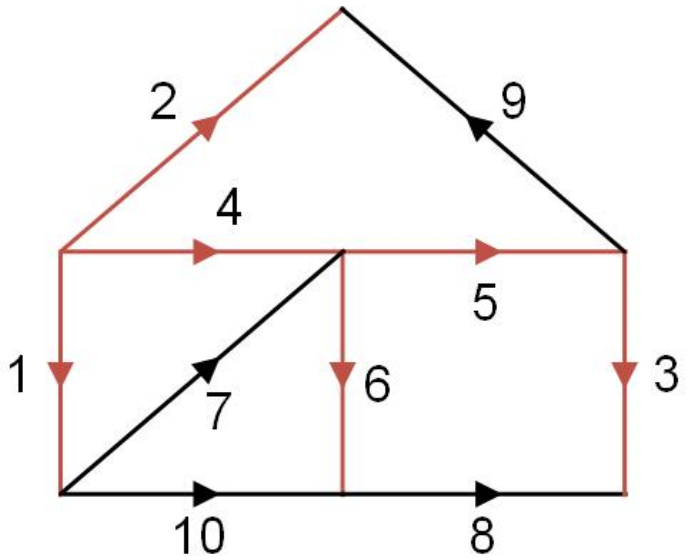
Twig Voltage Method



1. Circuit graph is drawn. A tree is chosen: voltage source should be a twig.





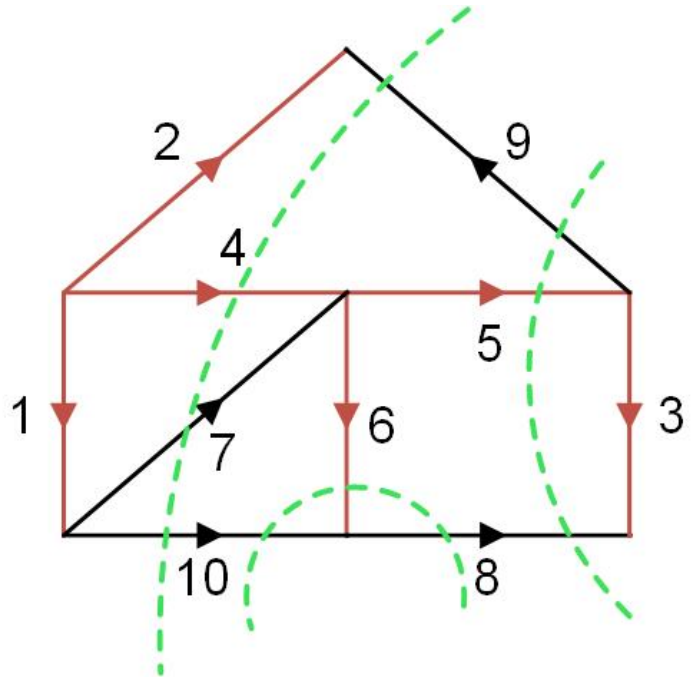


2. Fundamental cut set equations are written for the twigs with unknown voltages.

4: i_4 = …

5: i_5 = …

6: i_6 = …



3. i = Gv is inserted into the cut set equations

G_4v_4 = …

G_5v_5 = …

G_6v_6 = …

4. Link voltages is written in terms of twig voltages using loop equations.

V_7 = …

V_8 = …

V_9 = …

5. Twig voltages are inserted into fundamental cut set equations

G_4v_4 = …

G_5v_5 = …

G_6v_6 = …

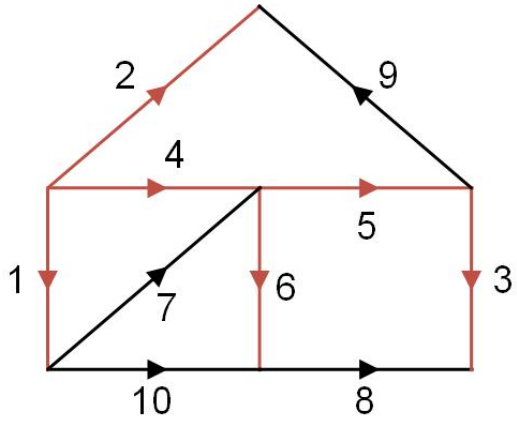
6. Unknown twig voltages (v_4, v_5, v_6) are written in terms of known voltages.

$$\begin{bmatrix} G_4+G_7+G_9 & G_9 & 0 \\ G_9 & G_5+G_8+G_9 & -G_8 \\ 0 & -G_8 & G_6+G_8 \end{bmatrix} \begin{bmatrix} V_4 \\ V_5 \\ V_6 \end{bmatrix} = \begin{bmatrix} G_7 & G_9 & 0 & -1 \\ 0 & G_9 & -G_8 & 0 \\ 0 & 0 & G_8 & -1 \end{bmatrix} \begin{bmatrix} V_{s1} \\ V_{s2} \\ V_{s3} \\ I_s \end{bmatrix}$$

$$\mathbf{Ax = Bu \rightarrow x = A^{-1}Bu}$$

Link Current Method

1. Fundamental loop equations are written for the unknown link currents.



V_7 = …

V_8 = …

V_9 = …

2. V = Ri is inserted into the fundamental loop equations.

$R_7 i_7$ = …

$R_8 i_8$ = …

$R_9 i_9$ = …

3. Twig currents are written in terms of link currents using cut set equations.

$i_4 = \ldots$

$i_5 = \ldots$

$i_6 = \ldots$

4. Twig currents are inserted into the fundamental loop equations.

$R_7 i_7 = \ldots$

$R_8 i_8 = \ldots$

$R_9 i_9 = \ldots$

5. Unknown link currents can be can be found in terms of known ones.

$$\begin{bmatrix} R_4 + R_7 & 0 & -R_4 \\ 0 & R_5 + R_6 + R_8 & -R_5 \\ -R_4 & -R_5 & R_4 + R_5 + R_9 \end{bmatrix} \begin{bmatrix} i_7 \\ i_8 \\ i_9 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 & -R_4 \\ 0 & 0 & 1 & R_6 \\ 0 & 1 & 0 & R_4 \end{bmatrix} \begin{bmatrix} V_{s1} \\ V_{s2} \\ V_{s3} \\ I_s \end{bmatrix}$$