APPENDIX - A [SADIKU]
CREMER’S RULE

$$\begin{bmatrix} 3 & -2 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$3I_1 - 2I_2 = 1$

$I_1 - 2I_2 = -1$

$$\Delta = \begin{vmatrix} 3 & -2 \\ -1 & 2 \end{vmatrix} = 6 - 2 = 4$$

$$\Delta_1 = \begin{vmatrix} 1 & -2 \\ 1 & 2 \end{vmatrix} = 2 + 2 = 4,$$

$$\Delta_2 = \begin{vmatrix} 3 & 1 \\ -1 & 1 \end{vmatrix} = 3 + 1 = 4$$

$$i_1 = \frac{\Delta_1}{\Delta} = 1\ \mathrm{A}, \qquad i_2 = \frac{\Delta_2}{\Delta} = 1\ \mathrm{A}$$

$$11i_1 - 5i_2 - 6i_3 = 12$$

$$-5i_1 + 19i_2 - 2i_3 = 0$$

$$-i_1 - i_2 + 2i_3 = 0$$

$$\begin{bmatrix} 11 & -5 & -6 \\ -5 & 19 & -2 \\ -1 & -1 & 2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 12 \\ 0 \\ 0 \end{bmatrix}$$

$$\Delta = \begin{array}{c|ccc|c} & 11 & -5 & -6 & \\ & -5 & 19 & -2 & \\ & -1 & -1 & 2 & \\ - & 11 & -5 & -6 & + \\ - & -5 & 19 & -2 & + \\ - & & & & + \end{array}$$

$$= 418 - 30 - 10 - 114 - 22 - 50 = 192$$

$$\Delta_1 = \begin{vmatrix} 12 & -5 & -6 \\ 0 & 19 & -2 \\ 0 & -1 & 2 \\ 12 & -5 & -6 \\ 0 & 19 & -2 \end{vmatrix} = 456 - 24 = 432$$

$$\Delta_2 = \begin{vmatrix} 11 & 12 & -6 \\ -5 & 0 & -2 \\ -1 & 0 & 2 \\ 11 & 12 & -6 \\ -5 & 0 & -2 \end{vmatrix} = 24 + 120 = 144$$

$$i_1 = \frac{\Delta_1}{\Delta} = \frac{432}{192} = 2.25 \text{ A}, \qquad i_2 = \frac{\Delta_2}{\Delta} = \frac{144}{192} = 0.75 \text{ A}$$

$$\Delta_3 = \begin{vmatrix} 11 & -5 & 12 \\ -5 & 19 & 0 \\ -1 & -1 & 0 \\ 11 & -5 & 12 \\ -5 & 19 & 0 \end{vmatrix} = 60 + 228 = 288$$

$$i_3 = \frac{\Delta_3}{\Delta} = \frac{288}{192} = 1.5 \text{ A}$$

PROBLEM SOLVING

Apply mesh analysis to find i_o in Fig. 3.87.

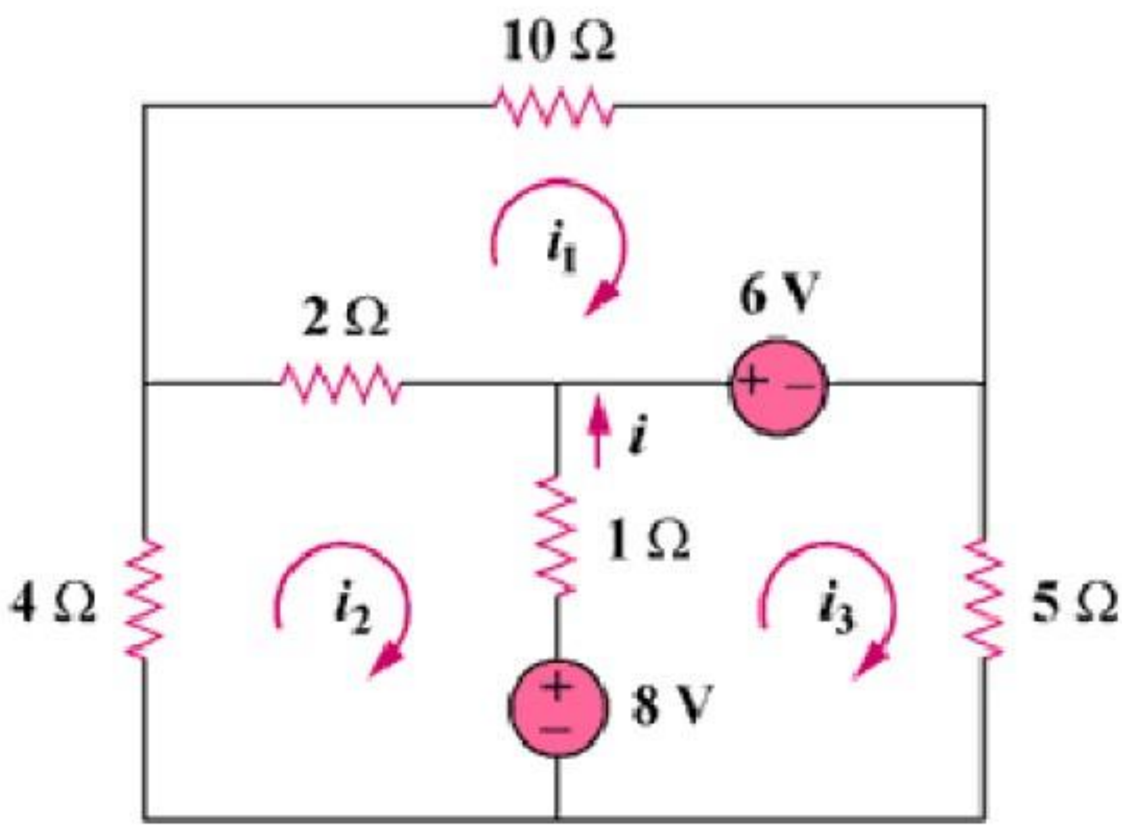


Figure 3.87

SOLUTION

For loop 1, $6 = 12i_1 - 2i_2 \longrightarrow 3 = 6i_1 - i_2$

For loop 2, $-8 = -2i_1 + 7i_2 - i_3$

For loop 3, $-8 + 6 + 6i_3 - i_2 = 0 \longrightarrow 2 = -i_2 + 6i_3$

$$\begin{bmatrix} 6 & -1 & 0 \\ 2 & -7 & 1 \\ 0 & -1 & 6 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 3 \\ 8 \\ 2 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} 6 & -1 & 0 \\ 2 & -7 & 1 \\ 0 & -1 & 6 \end{vmatrix} = -234, \quad \Delta_2 = \begin{vmatrix} 6 & 3 & 0 \\ 2 & 8 & 1 \\ 0 & 2 & 6 \end{vmatrix} = 240$$

$$\Delta_3 = \begin{vmatrix} 6 & -1 & 3 \\ 2 & -7 & 8 \\ 0 & -1 & 2 \end{vmatrix} = -38$$

$$\mathrm{i} = \mathrm{i}_3 - \mathrm{i}_2 = \frac{\Delta_3 - \Delta_2}{\Delta} = \frac{-38 - 240}{-234} = \underline{\mathbf{1.188\ A}}$$

PROBLEM SOLVING

Use mesh analysis to find $\boldsymbol{i_1}$, $\boldsymbol{i_2}$, and $\boldsymbol{i_3}$ in the circuit of Fig. 3.97.

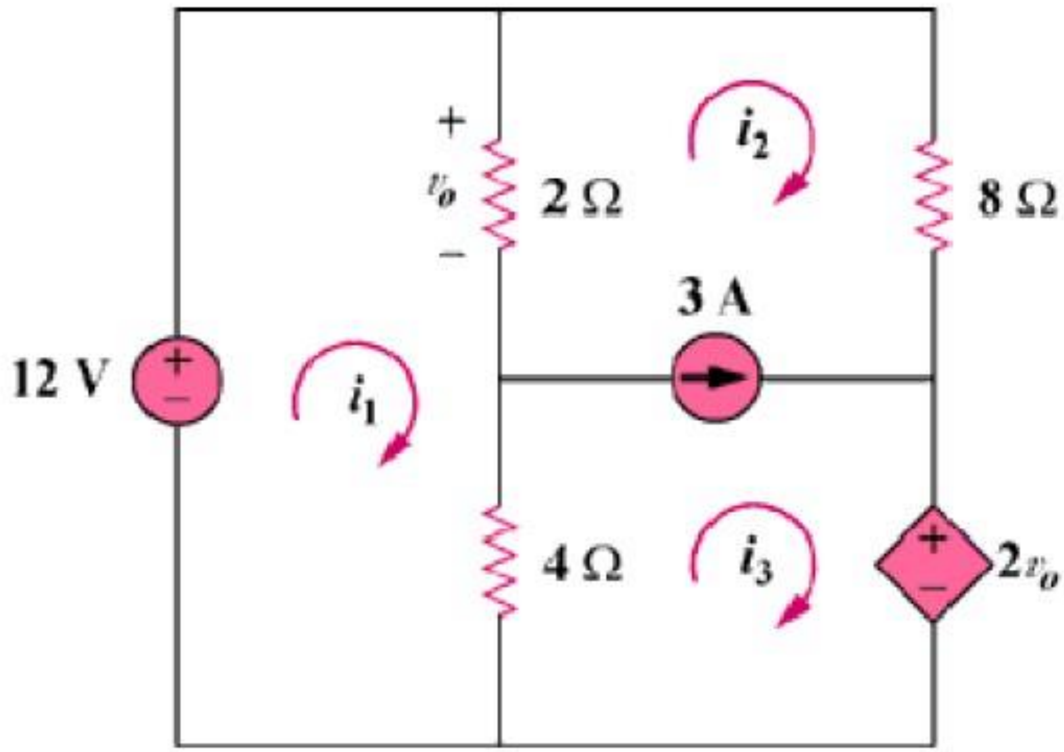
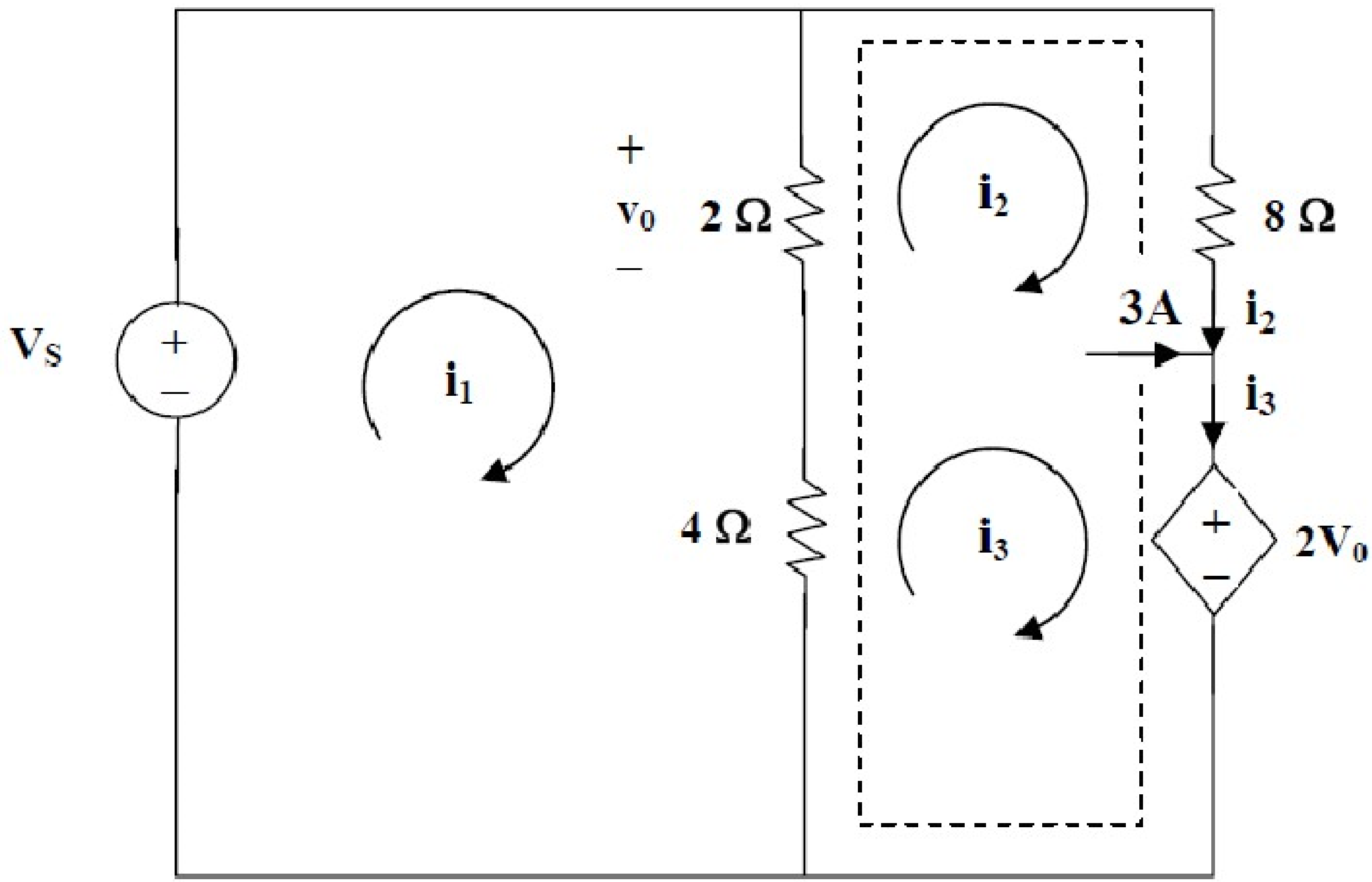


Figure 3.97

SOLUTION



For mesh 1,

$$2(i_1 - i_2) + 4(i_1 - i_3) - 12 = 0 \text{ which leads to } 3i_1 - i_2 - 2i_3 = 6$$

For the supermesh, $2(i_2 - i_1) + 8i_2 + 2v_0 + 4(i_3 - i_1) = 0$

But $v_0 = 2(i_1 - i_2)$ which leads to $-i_1 + 3i_2 + 2i_3 = 0$

For the independent current source, $i_3 = 3 + i_2$

$$i_1 = \underline{\mathbf{3.5\ A}},\ i_2 = \underline{\mathbf{-0.5\ A}},\ i_3 = \underline{\mathbf{2.5\ A}}.$$

PRACTICE PROBLEMS

SADIKU

- Exercise: 3.39, 3.40, 3.43, 3.44, 3.46, 3.49, 3.50, 3.58.

BOYLESTAD

- Section 8.7, Exercise: 25