Chapter 10, Solution 33.
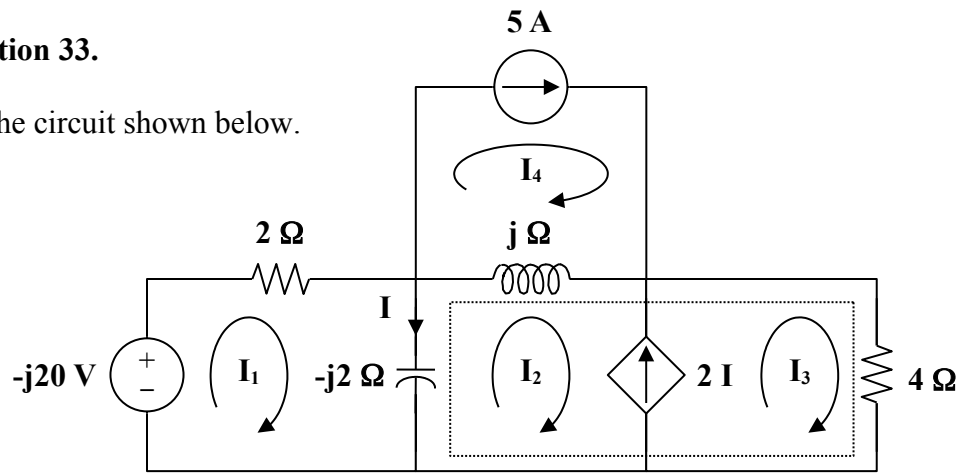
Consider the circuit shown below.

For mesh 1,
$$j20 + (2 - j2)\mathbf{I}_1 + j2\,\mathbf{I}_2 = 0$$
$$(1 - j)\mathbf{I}_1 + j\,\mathbf{I}_2 = -j10 \tag{1}$$

For the supermesh,
$$(j - j2)\mathbf{I}_2 + j2\,\mathbf{I}_1 + 4\,\mathbf{I}_3 - j\,\mathbf{I}_4 = 0 \tag{2}$$

Also,
$$\mathbf{I}_3 - \mathbf{I}_2 = 2\mathbf{I} = 2(\mathbf{I}_1 - \mathbf{I}_2)$$
$$\mathbf{I}_3 = 2\mathbf{I}_1 - \mathbf{I}_2 \tag{3}$$

For mesh 4,
$$\mathbf{I}_4 = 5 \tag{4}$$

Substituting (3) and (4) into (2),
$$(8 + j2)\mathbf{I}_1 - (-4 + j)\mathbf{I}_2 = j5 \tag{5}$$

Putting (1) and (5) in matrix form,
$$\begin{bmatrix} 1-j & j \\ 8+j2 & 4-j \end{bmatrix}\begin{bmatrix} \mathbf{I}_1 \\ \mathbf{I}_2 \end{bmatrix} = \begin{bmatrix} -j10 \\ j5 \end{bmatrix}$$

$$\Delta = -3 - j5, \qquad \Delta_1 = -5 + j40, \qquad \Delta_2 = -15 + j85$$

$$\mathbf{I} = \mathbf{I}_1 - \mathbf{I}_2 = \frac{\Delta_1 - \Delta_2}{\Delta} = \frac{10 - j45}{-3 - j5} =$$

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