

Chapter 10, Solution 25.

$$\omega = 2$$

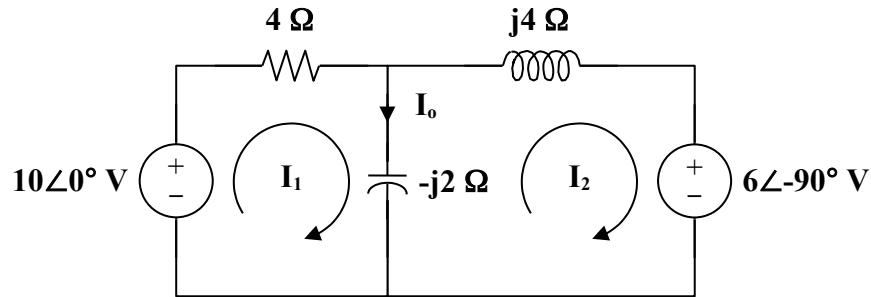
$$10 \cos(2t) \longrightarrow 10 \angle 0^\circ$$

$$6 \sin(2t) \longrightarrow 6 \angle -90^\circ = -j6$$

$$2 \text{ H} \longrightarrow j\omega L = j4$$

$$0.25 \text{ F} \longrightarrow \frac{1}{j\omega C} = \frac{1}{j(2)(1/4)} = -j2$$

The circuit is shown below.



For loop 1,

$$-10 + (4 - j2)\mathbf{I}_1 + j2\mathbf{I}_2 = 0$$

$$5 = (2 - j)\mathbf{I}_1 + j\mathbf{I}_2$$

(1)

For loop 2,

$$j2\mathbf{I}_1 + (j4 - j2)\mathbf{I}_2 + (-j6) = 0$$

$$\mathbf{I}_1 + \mathbf{I}_2 = 3$$

(2)

In matrix form (1) and (2) become

$$\begin{bmatrix} 2 - j & j \\ 1 & 1 \end{bmatrix} \begin{bmatrix} \mathbf{I}_1 \\ \mathbf{I}_2 \end{bmatrix} = \begin{bmatrix} 5 \\ 3 \end{bmatrix}$$

$$\Delta = 2(1 - j),$$

$$\Delta_1 = 5 - j3,$$

$$\Delta_2 = 1 - j3$$

$$\mathbf{I}_o = \mathbf{I}_1 - \mathbf{I}_2 = \frac{\Delta_1 - \Delta_2}{\Delta} = \frac{4}{2(1 - j)} = 1 + j = 1.4142 \angle 45^\circ$$

Therefore,

$$i_o(t) = 1.4142 \cos(2t + 45^\circ) \text{ A}$$