Chapter 10, Problem 1.

Determine i in the circuit of Fig. 10.50.

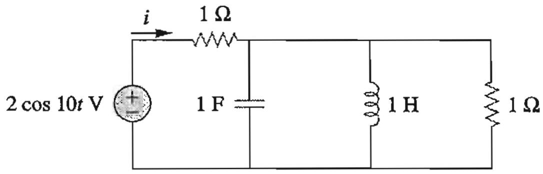


Figure 10.50
For Prob. 10.1.

Chapter 10, Solution 1.

We first determine the input impedance.

$$1H \longrightarrow j\omega L = j1x10 = j10$$

$$1F \longrightarrow \frac{1}{j\omega C} = \frac{1}{j10x1} = -j0.1$$

$$Z_{in} = 1 + \left(\frac{1}{j10} + \frac{1}{-j0.1} + \frac{1}{1}\right)^{-1} = 1.0101 - j0.1 = 1.015 < -5.653^o$$

$$I = \frac{2 < 0^o}{1.015 < -5.653^o} = 1.9704 < 5.653^o$$

$$i(t) = \underline{1.9704\cos(10t + 5.653^o)\ A} = \underline{\mathbf{1.9704cos(10t+5.65^\circ)\ A}}$$

Chapter 10, Problem 10.

PS ML

Use nodal analysis to find v_o in the circuit of Fig. 10.59. Let $\omega = 2$ krad/s.

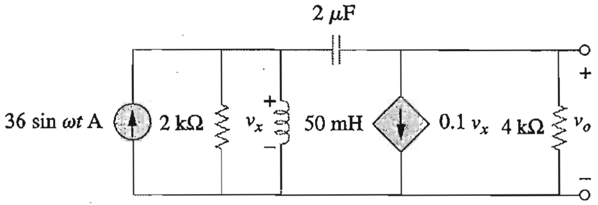


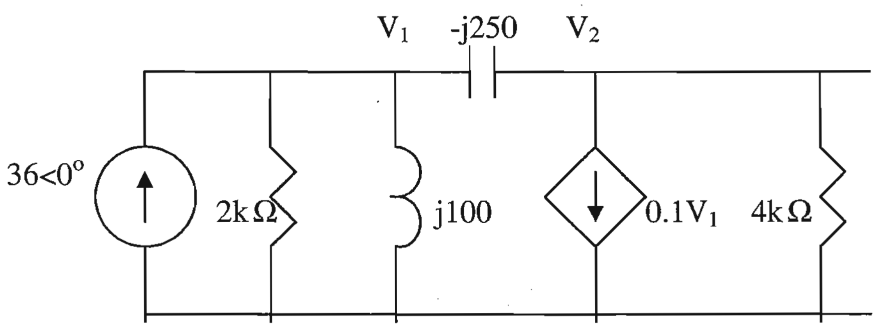
Figure 10.59
For Prob. 10.10.

Chapter 10, Solution 10.

$$50\text{ mH} \longrightarrow j\omega L = j2000x50x10^{-3} = j100, \qquad \omega = 2000$$

$$2\mu F \longrightarrow \frac{1}{j\omega C} = \frac{1}{j2000x2x10^{-6}} = -j250$$

Consider the frequency-domain equivalent circuit below.



At node 1,

$$36 = \frac{V_1}{2000} + \frac{V_1}{j100} + \frac{V_1 - V_2}{-j250} \longrightarrow 36 = (0.0005 - j0.006)V_1 - j0.004V_2 \quad (1)$$

At node 2,

$$\frac{V_1 - V_2}{-j250} = 0.1V_1 + \frac{V_2}{4000} \longrightarrow 0 = (0.1 - j0.004)V_1 + (0.00025 + j0.004)V_2 \quad (2)$$

Solving (1) and (2) gives

$$V_o = V_2 = -535.6 + j893.5 = 8951.1\angle 93.43^o$$

v_o (t) = <u>**8.951 sin(2000t +93.43°) kV**</u>

Chapter 10, Problem 13.

Determine V_x in the circuit of Fig. 10.62 using any method of your choice.

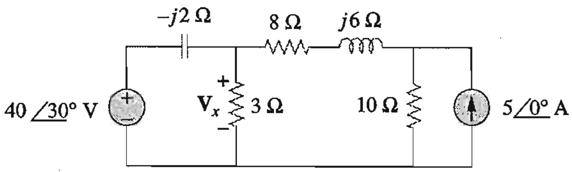
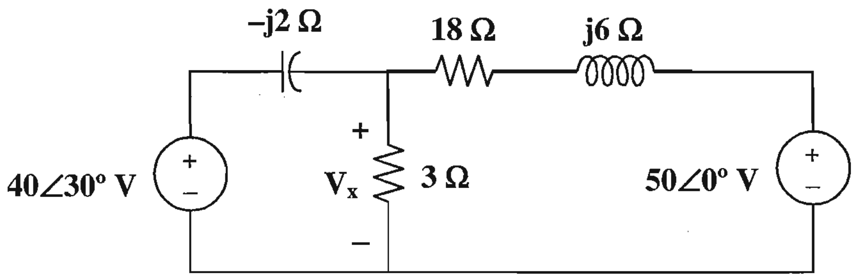


Figure 10.62
For Prob. 10.13.

Chapter 10, Solution 13.

Nodal analysis is the best approach to use on this problem. We can make our work easier by doing a source transformation on the right hand side of the circuit.



$$\frac{V_X - 40\angle 30^\circ}{-j2} + \frac{V_X}{3} + \frac{V_X - 50}{18 + j6} = 0$$

which leads to $V_X =$ **<u>29.36∠62.88° A</u>**.

Chapter 10, Problem 26.

Use mesh analysis to find current i_o in the circuit of Fig. 10.74.

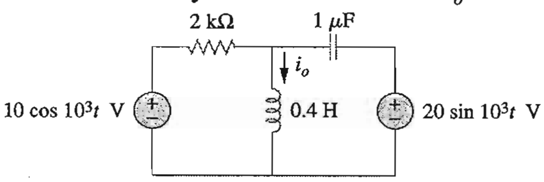


Figure 10.74

For Prob. 10.26.

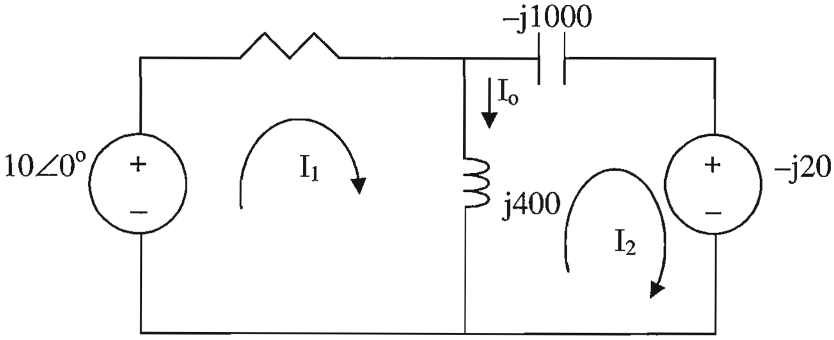
Chapter 10, Solution 26.

$$0.4H \longrightarrow j\omega L = j10^3 x0.4 = j400$$

$$1\mu F \longrightarrow \frac{1}{j\omega C} = \frac{1}{j10^3 x10^{-6}} = -j1000$$

$$20\sin 10^3 t = 20\cos(10^3 t - 90^o) \longrightarrow 20 < -90 = -j20$$

The circuit becomes that shown below.



For loop 1,

$$-10 + (12000 + j400)I_1 - j400I_2 = 0 \longrightarrow 1 = (200 + j40)I_1 - j40I_2 \quad (1)$$

For loop 2,

$$-j20 + (j400 - j1000)I_2 - j400I_1 = 0 \longrightarrow -12 = 40I_1 + 60I_2$$

(2)

In matrix form, (1) and (2) become

$$\begin{bmatrix} 1 \\ -12 \end{bmatrix} = \begin{bmatrix} 200 + j40 & -j40 \\ 40 & 60 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

Solving this leads to

I_1 =0.0025-j0.0075, I_2= -0.035+j0.005

$$I_o = I_1 - I_2 = 0.0375 - j0.0125 = 39.5 < -18.43 \text{ mA}$$

$$i_o = 39.5\cos(10^3 t - 18.43^o) \text{ mA}$$

Chapter 10, Problem 27.

ML

Using mesh analysis, find $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit of Fig. 10.75.

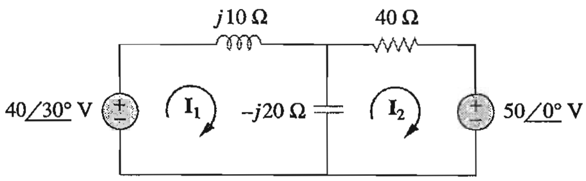


Figure 10.75
For Prob. 10.27.

Chapter 10, Solution 27.

For mesh 1,

$$-40\angle 30° + (j10 - j20)\mathbf{I}_1 + j20\mathbf{I}_2 = 0$$

$$4\angle 30° = -j\mathbf{I}_1 + j2\mathbf{I}_2 \qquad (1)$$

For mesh 2,

$$50\angle 0° + (40 - j20)\mathbf{I}_2 + j20\mathbf{I}_1 = 0$$

$$5 = -j2\mathbf{I}_1 - (4 - j2)\mathbf{I}_2 \qquad (2)$$

From (1) and (2),

$$\begin{bmatrix} 4\angle 30° \\ 5 \end{bmatrix} = \begin{bmatrix} -j & j2 \\ -j2 & -(4-j2) \end{bmatrix} \begin{bmatrix} \mathbf{I}_1 \\ \mathbf{I}_2 \end{bmatrix}$$

$$\Delta = -2 + 4j = 4.472\angle 116.56°$$

$$\Delta_1 = -(4\angle 30°)(4 - j2) - j10 = 21.01\angle 211.8°$$

$$\Delta_2 = -j5 + 8\angle 120° = 4.44\angle 154.27°$$

$$\mathbf{I}_1 = \frac{\Delta_1}{\Delta} = \underline{\mathbf{4.698\angle 95.24°\ A}}$$

$$\mathbf{I}_2 = \frac{\Delta_2}{\Delta} = \underline{\mathbf{0.9928\angle 37.71°\ A}}$$