8.95 Use source exchange to determine $\mathbf{V}_o$ in the network in Fig. P8.95.

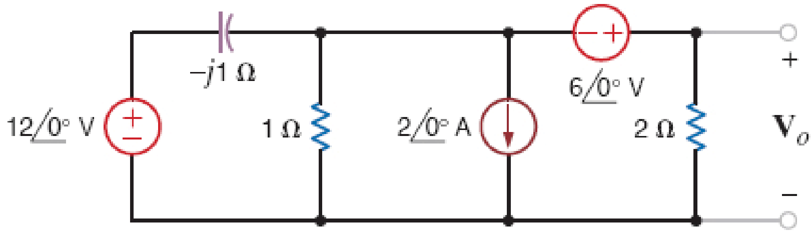
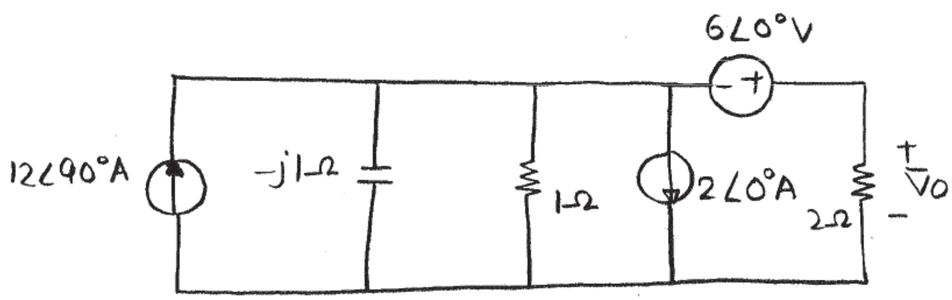
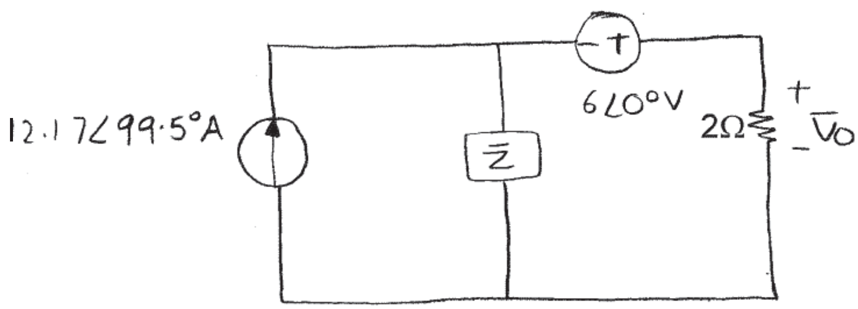


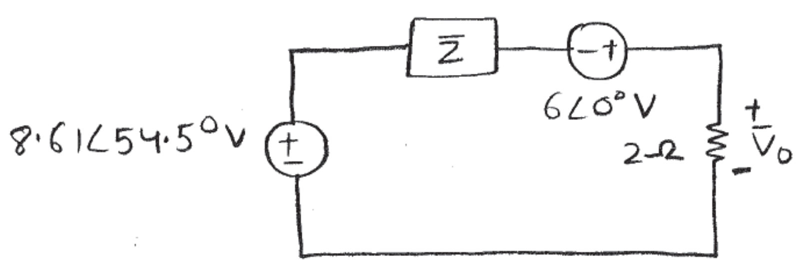
Figure P8.95

SOLUTION:





$$\bar{Z} = 1 \| -j1 = \frac{1(-j1)}{1-j1} = 0.707\angle -45^\circ\,\Omega$$



$$\bar{V}_0 = \left(\frac{2}{2 + 0.707\angle -45^\circ}\right)\left(6\angle 0^\circ + 8.61\angle 54.5^\circ\right)$$

$$\bar{V}_0 = 10.23\angle 43.82^\circ \text{ V}$$

8.113 Find $\mathbf{V}_x$ in the circuit in Fig. P8.113 using Norton's theorem.

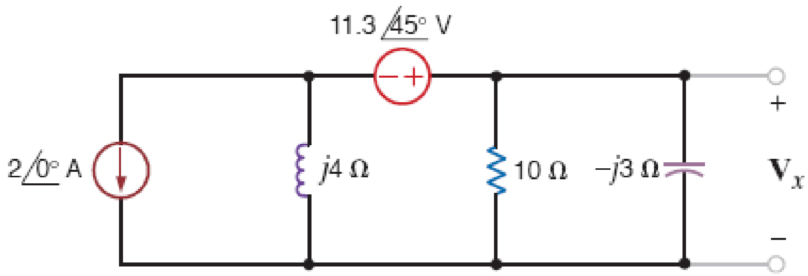
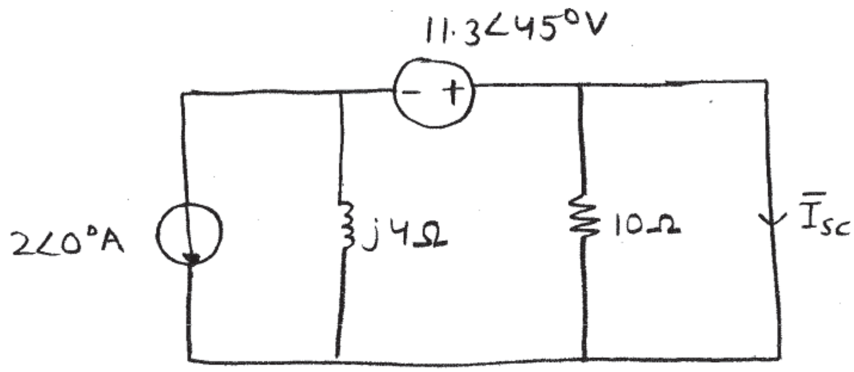
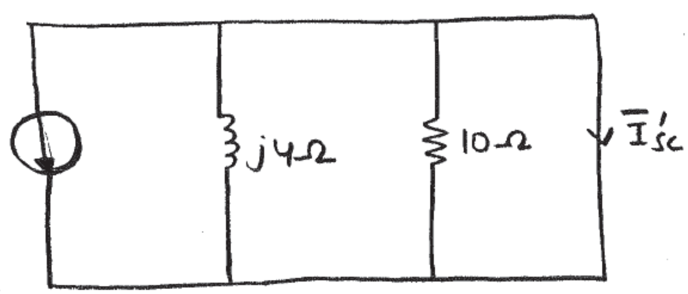


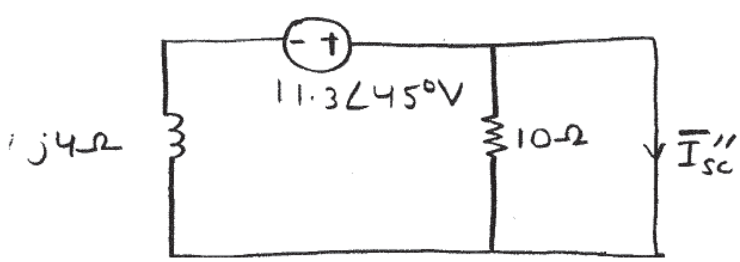
Figure P8.113

SOLUTION:





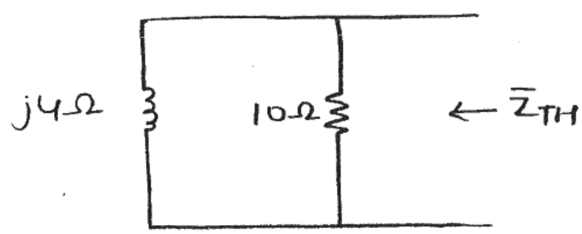
$$\bar{I}'_{sc} = -2\angle 0^\circ \text{A}$$



$$\bar{I}_{SC}'' = \frac{11.3\angle 45^\circ}{j4} = 2.83\angle -45^\circ \text{ A}$$

$$\bar{I}_{SC} = \bar{I}_{SC}' + \bar{I}_{SC}'' = -2\angle 0^\circ + 2.83\angle -45^\circ$$

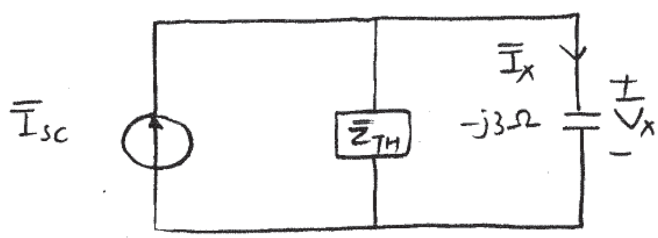
$$\bar{I}_{SC} = 2\angle -90^\circ \text{ A}$$



$$\bar{Z}_{TH} = 10 \| j4$$

$$\bar{Z}_{TH} = \frac{10(j4)}{10+j4}$$

$$\bar{Z}_{TH} = 3.7\angle 68.2^\circ \, \Omega$$



$$\bar{I}_X = \left(\frac{3.7\angle 68.2^\circ}{3.7\angle 68.2^\circ - j3}\right)(2\angle -90^\circ)$$

$$\bar{I}_X = 5.13\angle -39.38^\circ \text{ A}$$

$$\bar{V}_X = -j3(5.13\angle -39.38^\circ)$$

$$\bar{V}_X = 15.4\angle 129.4^\circ \text{ V}$$

8.125 Calculate the Thévenin equivalent impedance $\mathbf{Z}_{Th}$ in the circuit shown in Fig. P8.125.

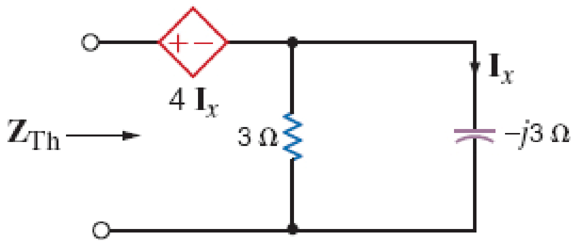
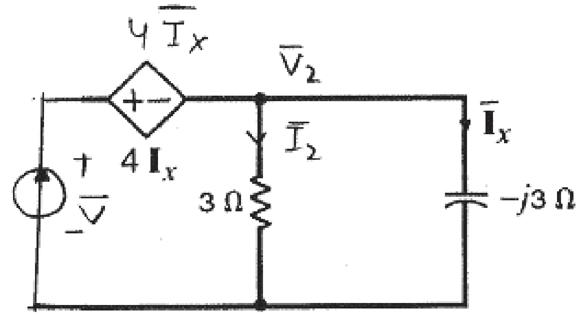


Figure P8.125

SOLUTION:

$\bar{I} = 1\angle 0° A$



KCL at ② : $1\angle 0° = \bar{I}_2 + \bar{I}_x$

$$\frac{\bar{V}_2}{3} + \frac{\bar{V}_2}{-j3} = 1\angle 0°$$

$$-j1\bar{V}_2 + \bar{V}_2 = -j3(1\angle 0°)$$

$$\bar{V}_2(1-j1) = 3\angle -90°$$

$$\bar{V}_2 = 2.12\angle -45° \text{ V}$$

$$\bar{I}_2 = \frac{\bar{V}_2}{3} = \frac{2.12\angle -45°}{3} = 0.707\angle -45° \text{A}$$

$$\bar{I}_x = \frac{\bar{V}_2}{-j3} = \frac{2.12\angle -45°}{-j3} = 0.707\angle 45° \text{A}$$

KVL: $\bar{V} = 4\bar{I}_x + 3\bar{I}_2$

$$\bar{V} = 4(0.707\angle 45^\circ) + 3(7.07\angle -45^\circ)$$

$$\bar{V} = 3.54\angle 8.13^\circ \text{ V}$$

$$\bar{Z}_{TH} = \frac{\bar{V}}{\bar{I}} = \frac{3.54\angle 8.13^\circ}{1\angle 0^\circ}$$

$$\bar{Z}_{TH} = 3.54\angle 8.13^\circ\ \Omega$$

12.1 Determine the driving point impedance at the input terminals of the network shown in Fig. P12.1 as a function of s.

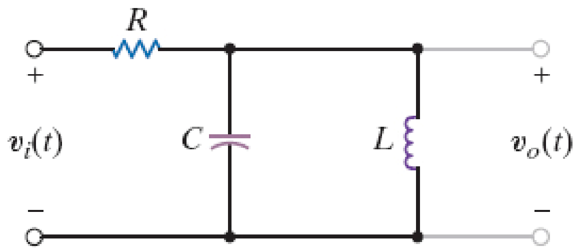
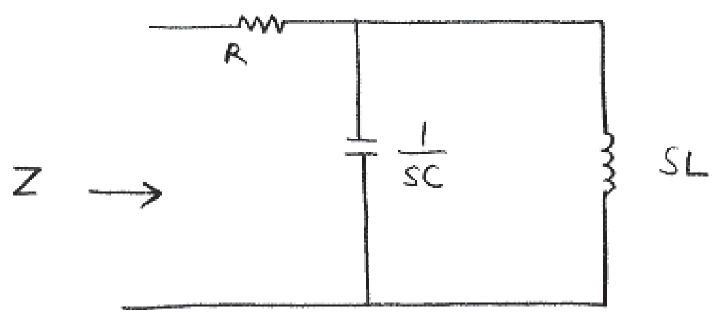


Figure P12.1

SOLUTION:



$$Z = R + \left(\frac{1}{sC} \parallel sL \right)$$

$$Z = R + \frac{\frac{1}{sC}(sL)}{\frac{1}{sC} + sL}$$

$$Z = R + \frac{\frac{L}{C}}{\frac{s^2LC+1}{sC}}$$

$$Z = R + \frac{sL}{s^2LC+1}$$

$$Z = \frac{R(S^2LC+1)+SL}{S^2LC+1}$$

$$Z = R\left[\frac{S^2 + \frac{S}{RC} + \frac{1}{LC}}{S^2 + \frac{1}{LC}}\right]$$

12.8 Find the transfer impedance $\mathbf{V}_o(s)/\mathbf{I}_s(s)$ for the network shown in Fig. P12.8.

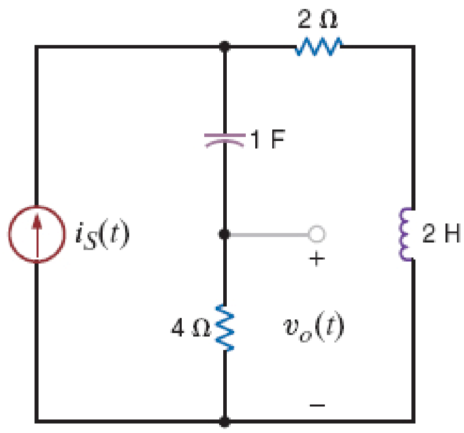
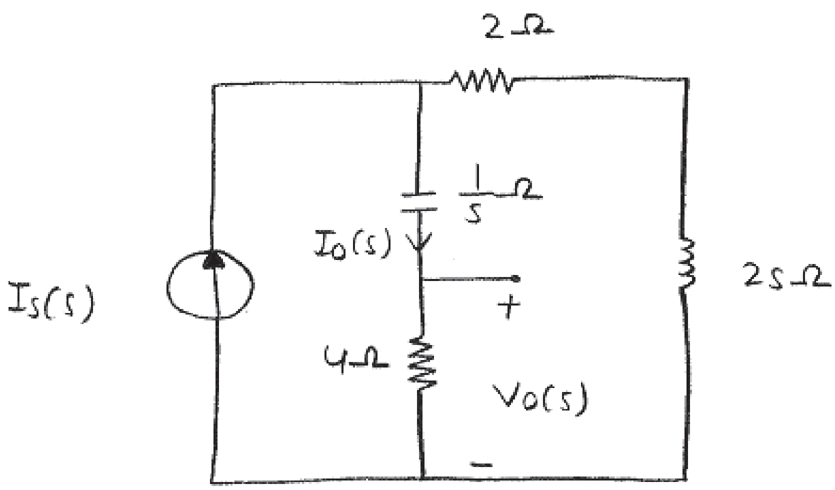


Figure P12.8

SOLUTION:



$$I_o = \left(\frac{2+2s}{2+2s+\frac{1}{s}+4} \right) I_s$$

$$I_o = \frac{2s+2}{\frac{2s^2+2s+4s+1}{s}} I_s$$

$$I_o = \frac{2s(s+1)}{2s^2+6s+1} I_s$$

$$\frac{I_O}{I_S} = \frac{2s(s+1)}{2s^2+6s+1}$$

$$\frac{V_O}{I_S} = \frac{4I_O}{I_S} = 4\left[\frac{2s(s+1)}{2s^2+6s+1}\right]$$

$$\frac{V_O}{I_S} = \frac{8s(s+1)}{2s^2+6s+1}$$

12.9 Draw the Bode plot for the network function

$$\mathbf{H}(j\omega) = \frac{j\omega 4 + 1}{j\omega 20 + 1}$$

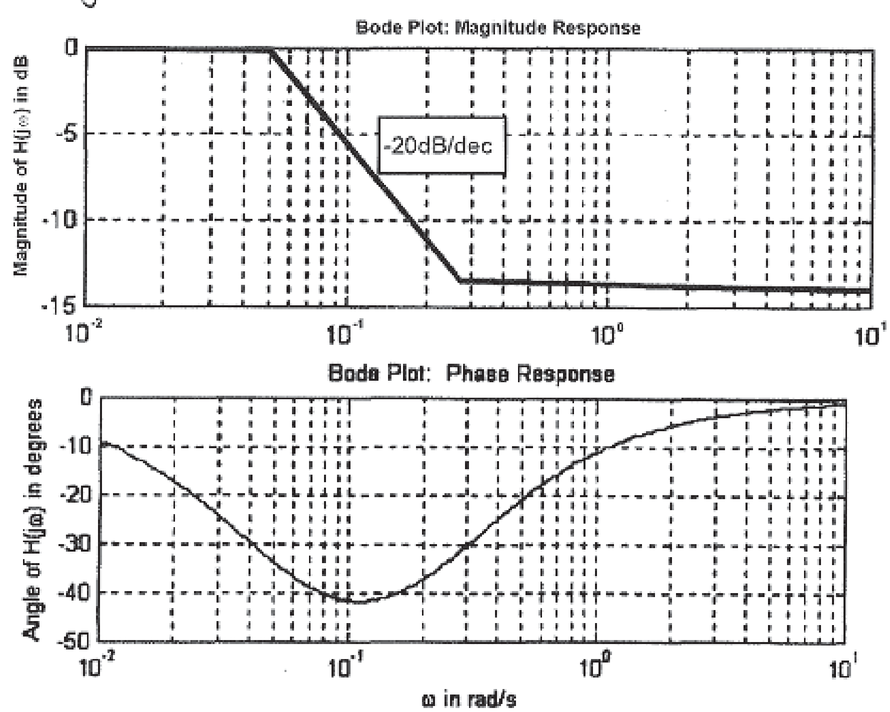
SOLUTION:

$$H(j\omega) = \frac{j\omega 4 + 1}{j\omega 20 + 1}$$

$$H(\omega) = \frac{1}{5}\,\frac{j\omega + 1/4}{j\omega + 1/20}$$

$$Mag(\omega) = 20 \times \log\left[\sqrt{\frac{(1+16\omega^2)}{(1+400\omega^2)}}\right]$$

$$angle(\omega) = \tan^{-1}(4\omega) - \tan^{-1}(20\omega)$$



12.10 Draw the Bode plot for the network function

$$\mathbf{H}(j\omega) = \frac{j\omega}{(j\omega + 1)(0.1j\omega + 1)}$$

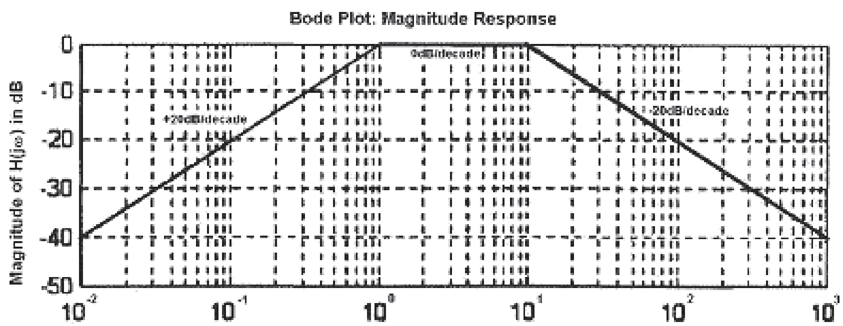
SOLUTION:

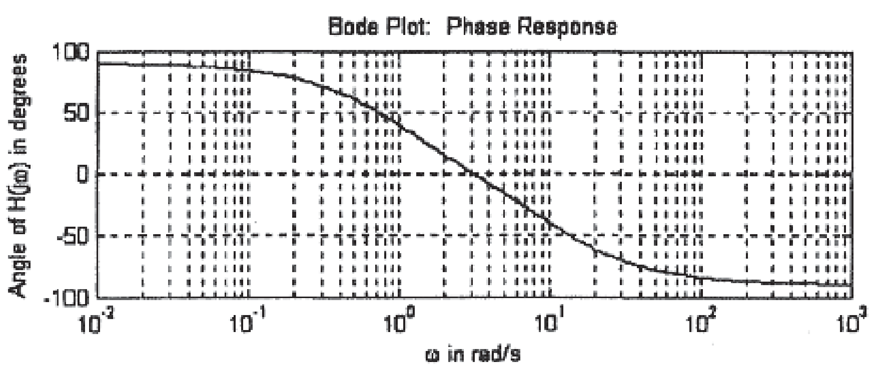
$$H(j\omega) = \frac{j\omega}{(j\omega+1)(0.1j\omega+1)}$$

$$H(j\omega) = \frac{10j\omega}{(j\omega+1)(j\omega+10)}$$

$$Mag(\omega) = 20 \times \log\left(\sqrt{\frac{100\omega^2}{(1+\omega^2)(\omega^2+100)}}\right)$$

$$angle(\omega) = +90^\circ - \tan^{-1}(\omega) - \tan^{-1}\left(\frac{\omega}{10}\right)$$





12.13 Sketch the magnitude characteristic of the Bode plot for the transfer function

$$\mathbf{H}(j\omega) = \frac{20(0.1j\omega + 1)}{j\omega(j\omega + 1)(0.01j\omega + 1)}$$

SOLUTION:

$$H(j\omega) = \frac{20(0 \cdot 1j\omega + 1)}{j\omega(j\omega+1)(0 \cdot 01j\omega+1)}$$

$$H(j\omega) = \frac{20(0 \cdot 1)\ (j\omega+10)}{j\omega(j\omega+1)(0 \cdot 01)(j\omega+100)}$$

$$H(j\omega) = \frac{200(j\omega+10)}{j\omega(j\omega+1)(j\omega+100)}$$

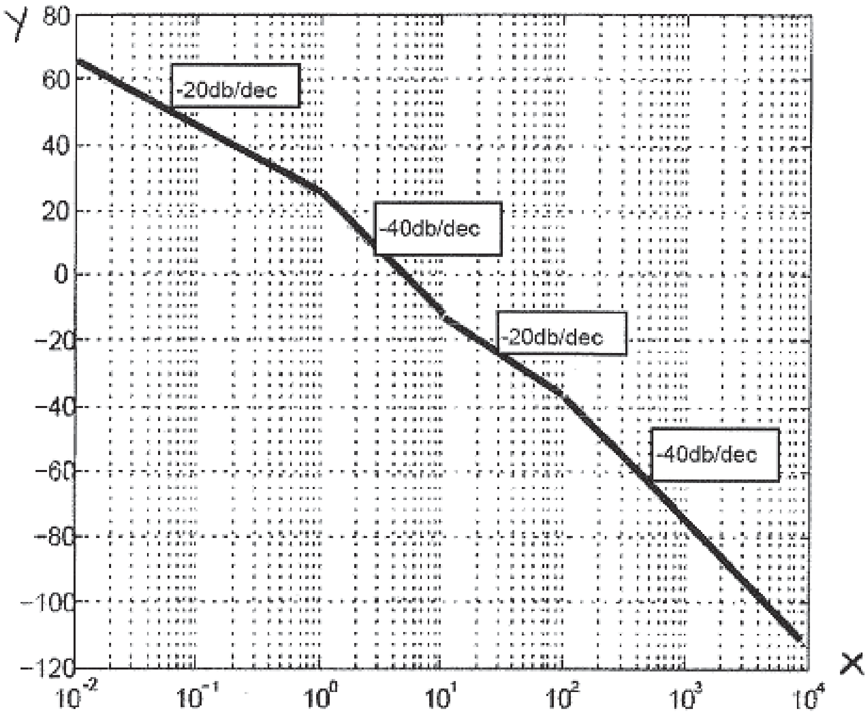
as $\omega \to 0$

$$|H(j\omega)| \longrightarrow \frac{20}{\omega}$$

$$|H|\Big|_{\omega=0 \cdot 1} = \frac{200(10)}{(0 \cdot 1)(1)(100)}$$

$$= 200$$

$$= 46\,dB$$



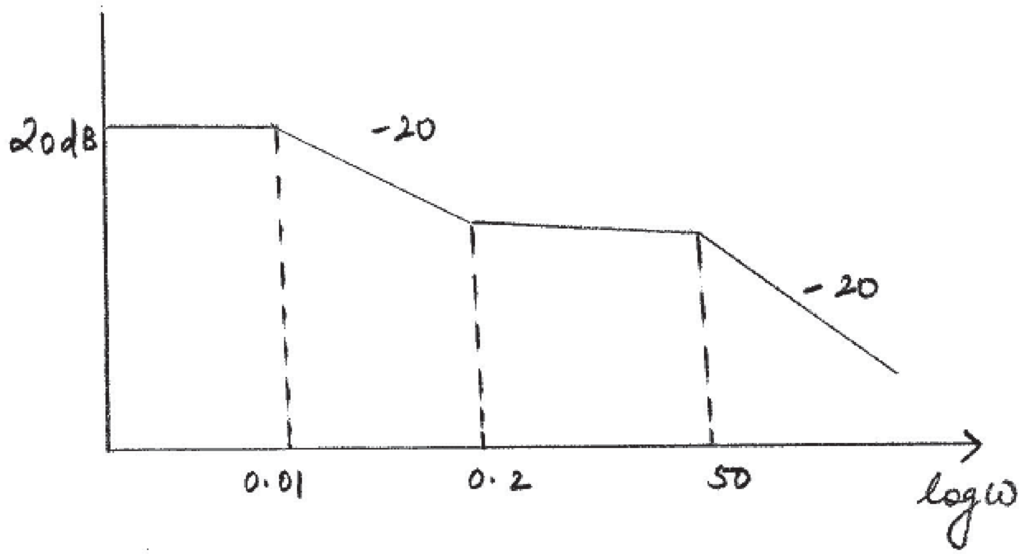
x axis: w in radian/sec

y axis: Mag $|H(jw)|$ in dB

12.21 Sketch the magnitude characteristic of the Bode plot for the transfer function

$$\mathrm{H}(j\omega) = \frac{10(5j\omega + 1)}{(100j\omega + 1)(0.02j\omega + 1)}$$

SOLUTION:



12.27 Find $\mathbf{H}(j\omega)$ if its magnitude characteristic is shown in Fig. P12.27.

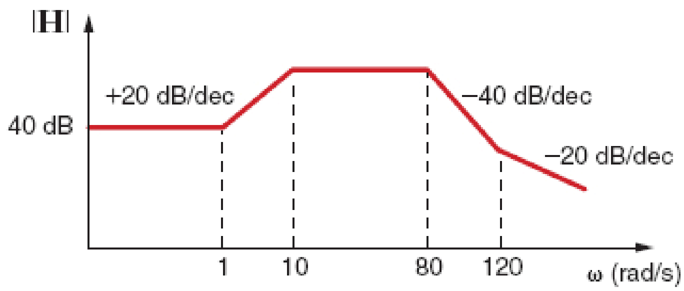


Figure P12.27

SOLUTION:

poles exist at :

10 rad/s

double pole at 80 rad/s

zeroes exist at :

1 rad/s

120 rad/s

$$H(j\omega) = \frac{K(j\omega+1)\ (j\omega+120)}{(j\omega+10)\ (j\omega+80)^2}$$

for $\omega << 1$

$$|H(j\omega)| = 40\,dB = 100$$

$$100 = \frac{K(1)\ (120)}{10\,(80)^2}$$

$$K = 5.33 \times 10^4$$

$$H(j\omega) = \frac{5.33 \times 10^4 \, (j\omega + 1)(j\omega + 120)}{(j\omega + 10)(j\omega + 80)^2}$$