

PS #21 Solutions

14.57b

$$\mathbf{Z}(s) = sL + R \parallel (R + sL) = sL + \frac{R(R + sL)}{2R + sL}$$

$$\mathbf{Z}(s) = \frac{R^2 + 3sRL + s^2L^2}{2R + sL}$$

$$\mathbf{I} = \frac{\mathbf{V}_s}{\mathbf{Z}}, \quad \mathbf{I}_1 = \frac{R}{2R + sL} \mathbf{I} = \frac{R \mathbf{V}_s}{\mathbf{Z}(2R + sL)}$$

$$\mathbf{V}_o = \mathbf{I}_1 \cdot sL = \frac{sLR \mathbf{V}_s}{2R + sL} \cdot \frac{2R + sL}{R^2 + 3sRL + s^2L^2}$$

$$\mathbf{H}(s) = \frac{\mathbf{V}_o}{\mathbf{V}_s} = \frac{sRL}{R^2 + 3sRL + s^2L^2} = \frac{\frac{1}{3} \left(\frac{3R}{L} s \right)}{s^2 + \frac{3R}{L} s + \frac{R^2}{L^2}}$$

$$\text{Thus, } \omega_0 = \frac{R}{L} = \underline{\underline{1 \text{ rad/s}}}$$

$$B = \frac{3R}{L} = \underline{\underline{3 \text{ rad/s}}}$$

Chapter 14, Solution 58.

$$(a) \quad \omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(0.1)(40 \times 10^{-12})}} = \underline{\underline{0.5 \times 10^6 \text{ rad/s}}}$$

$$(b) \quad B = \frac{R}{L} = \frac{2 \times 10^3}{0.1} = 2 \times 10^4$$

$$Q = \frac{\omega_0}{B} = \frac{0.5 \times 10^6}{2 \times 10^4} = 25$$

As a high Q circuit,

$$\omega_1 = \omega_0 - \frac{B}{2} = 10^4 (50 - 1) = \underline{\underline{490 \text{ krad/s}}}$$

$$\omega_2 = \omega_0 + \frac{B}{2} = 10^4 (50 + 1) = \underline{\underline{510 \text{ krad/s}}}$$

$$(c) \quad \text{As seen in part (b),} \quad Q = \underline{\underline{25}}$$