Week 4 Homework

Bryan SebaRaj

Professor Hong Tang

EENG 203 - Circuits and System Design

February 11, 2025

Homework for February 4, 2025

14.35

In a parallel RLC circuit,

(a) $\omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{8mH \cdot 60\mu F} = 1443.38$ rad/s

(b) $B = \frac{1}{RC} = \frac{1}{5k\Omega \cdot 60\mu F} = 3.33$ rad/s

(c) $Q = \omega_o RC = 1443.38$ rads/s $\cdot 5k\Omega \cdot 60\mu F = 433.01$

14.40

In a parallel resonance circuit,

(a) From $B = \frac{1}{RC}$,

$$C = \frac{1}{BR} = \frac{1}{(\omega_2 - \omega_1)R} = \frac{1}{2\pi(f_2 - f_1)R} = \frac{1}{2\pi(4kHz) \cdot 2k\Omega} = 19.894 \text{ nF}$$

(b) From $\omega_0 = \frac{1}{\sqrt{LC}}$,

$$L = \frac{1}{\omega_o^2 C} = \frac{1}{\left(\frac{\omega_1 + \omega_2}{2}\right)^2 \cdot C} = \frac{1}{(2\pi f_0 \cdot)^2 \cdot C} = 164.42\mu H$$

(c) $\omega_0 = \frac{\omega_1 + \omega_2}{2} = 2\pi \frac{f_1 + f_2}{2} = 2\pi \cdot 88kHz = 552.92$ krad/s

(d) $B = \omega_2 - \omega_1 = 2\pi(f_2 - f_1) = 8\pi$ krad/s $= 25.13$ krad/s

(e) $Q = \frac{\omega_0}{B} = \frac{176\pi}{8\pi} = 22$

Homework for February 6, 2025

14.50

Note that $H(\omega) = \frac{V_o}{V_i} = \frac{j\omega L}{R + j\omega L}$

$H(0) = \frac{0}{R+0} = 0$ and $H(\infty) = \frac{j\infty L}{R + j\infty L} = 1$. Therefore, the given circuit is a high pass filter.

Calculating the corner frequency, using $H(\omega_c) = \frac{1}{\sqrt{2}}$,

$$H(\omega_c) = \frac{1}{\sqrt{1 + \left(\frac{R}{\omega_c L}\right)^2}}$$

$$\sqrt{1 + \left(\frac{R}{\omega_c L}\right)^2} = \sqrt{2}$$

$$\frac{R}{\omega_c L} = \sqrt{1} = 1$$

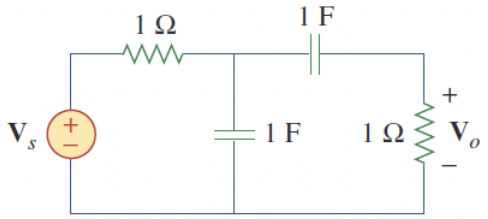
$$\omega_c = \frac{R}{L}$$

$$2\pi f_c = \frac{R}{L}$$

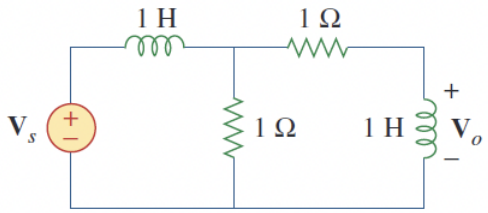
$$f_c = \frac{R}{2\pi L} = 318.3 \text{ Hz}$$

14.57

14.57 Determine the center frequency and bandwidth of the bandpass filters in Fig. 14.88.



(a)



(b)

Figure 14.88
For Prob. 14.57.

(a) First, the input impedance can be calculated as

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

$$Z(s) = R + \frac{RsC + 1}{sC \cdot sC \cdot \left(R + \frac{2}{SC}\right)} = R + \frac{RsC + 1}{2sC + s^2RC^2}$$

(b)