PS #22 Solutions

Chapter 14, Solution 62.

This is a highpass filter.

$$\mathbf{H}(\omega) = \frac{j\omega RC}{1 + j\omega RC} = \frac{1}{1 - j/\omega RC}$$

$$\mathbf{H}(\omega) = \frac{1}{1 - j\omega_c/\omega}, \qquad \omega_c = \frac{1}{RC} = 2\pi(1000)$$

$$\mathbf{H}(\omega) = \frac{1}{1 - jf_c/f} = \frac{1}{1 - j1000/f}$$

(a) $$\mathbf{H}(f = 200\text{ Hz}) = \frac{1}{1 - j5} = \frac{\mathbf{V}_o}{\mathbf{V}_i}$$

$$|\mathbf{V}_o| = \frac{120\text{ mV}}{|1 - j5|} = \underline{\mathbf{23.53\ mV}}$$

(b) $$\mathbf{H}(f = 2\text{ kHz}) = \frac{1}{1 - j0.5} = \frac{\mathbf{V}_o}{\mathbf{V}_i}$$

$$|\mathbf{V}_o| = \frac{120\text{ mV}}{|1 - j0.5|} = \underline{\mathbf{107.3\ mV}}$$

(c) $$\mathbf{H}(f = 10\text{ kHz}) = \frac{1}{1 - j0.1} = \frac{\mathbf{V}_o}{\mathbf{V}_i}$$

$$|\mathbf{V}_o| = \frac{120\text{ mV}}{|1 - j0.1|} = \underline{\mathbf{119.4\ mV}}$$

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Chapter 14, Solution 67.

$$\text{DC gain} = \frac{R_f}{R_i} = \frac{1}{4} \quad \longrightarrow \quad R_i = 4R_f$$

$$\text{Corner frequency} = \omega_c = \frac{1}{R_f C_f} = 2\pi(500)\ \text{rad/s}$$

If we select $R_f = 20\ \text{k}\Omega$, then $R_i = 80\ \text{k}\Omega$ and

$$C = \frac{1}{(2\pi)(500)(20\times 10^3)} = 15.915\ \text{nF}$$

Therefore, if $R_f =$ **20 kΩ**, then $R_i =$ **80 kΩ** and $C =$ **15.915 nF**

Chapter 14, Solution 69.

This is a highpass filter with $f_c = 2$ kHz.

$$\omega_c = 2\pi f_c = \frac{1}{RC}$$

$$RC = \frac{1}{2\pi f_c} = \frac{1}{4\pi\times 10^3}$$

10^8 Hz may be regarded as high frequency. Hence the high-frequency gain is

$$\frac{-R_f}{R} = \frac{-10}{4} \qquad \text{or} \qquad R_f = 2.5R$$

If we let $R =$ **10 kΩ**, then $R_f =$ **25 kΩ**, and $C = \dfrac{1}{4000\pi\times 10^4} =$ **7.96 nF**.

Fundamentals of Electric Circuits, 3/e, Charles Alexander, Matthew Sadiku
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