10. What kind of symmetries does the function above show? Fix $t = 0$ to make the function (a) odd, and (b) even. For both cases, use symmetries to calculate $a_n, a_k,$ and $b_k$ with the least amount of computation.

\[ \frac{12 + 4 + 4}{2} \times \frac{2}{C} \]

2. Classify the filters in (a) and (b) as low-pass, high-pass, band-pass, band-stop or none of the above. Give justification based on mathematics and/or circuit element characteristics based reasoning.

\[ 8 + 1 \]

\[ 8 + 12 \]
Odd Function:

\[ f(t) \]

\[ a_n = 0 \quad \text{(odd function)} \]

\[ a_k = 0 \quad \text{(all } k, \text{ odd function)} \]

\[ b_k = 0 \quad \text{(} k \text{ even, } \text{HW symmetry)} \]

\[ b_k = \frac{8}{T} \int_{0}^{T/4} f(t) \sin(k \frac{2\pi}{T} t) \, dt \quad , \quad k \text{ odd} \]

\[ = \frac{1}{T} \int_{0}^{2} f(t) \sin\left(\frac{k \cdot \pi}{4} t\right) dt \]

\[ = \frac{y}{k \pi} \left[ 3 \cos\left(\frac{k \pi}{4} 0\right) - 3 \cos\left(\frac{k \pi}{4} \frac{1}{4}\right) + 2 \cos\left(\frac{k \pi}{4} \frac{2}{4}\right) \right] \]

\[ = \frac{y}{k \pi} \left[ 3 - \cos\left(\frac{k \pi}{4}\right) - 2 \cos\left(\frac{k \pi}{2}\right) \right] \]

\[ = \frac{y}{k \pi} \left( 3 - \cos\left(\frac{k \pi}{4}\right) \right) \quad , \quad k \text{ odd} \]
2. (a) is bandstop filter. Equivalent impedance for LC combination is \( Z_{eq} = j\omega L \cdot \frac{1}{j\omega C} \)

\[
Z_{eq} = \frac{L/R \times \omega L}{j(\omega^2 L C - 1)} = -j\omega L
\]

At low and high \( \omega \), \( Z_{eq} \) is small and input voltage drops across resistor. At \( \omega = 1/\sqrt{LC} \), all voltage drops across LC combo and resistance.
Solutions (Pg. 3)

Thus, there is output voltage at low and high frequencies and small output at the center frequency. Thus, this is a bandpass.

(b) is a bandpass. \( Z_{eq} = j(wC - \frac{1}{wL}) \)

At low frequencies, input voltage drop across capacitor, at high frequencies, input drops across inductor. At the center frequency, the inductive and capacitive impedances cancel each other out and most input voltage drops across the resistor.