**Problem 5.51 :**

**Given:** The definition of Fourier transform.

$$\mathbf{X}(\omega) = \mathbf{F}\big[x(t)\big] = \int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt \tag{1}$$

**Find:** Using the definition of Fourier transform, prove that

$$\mathbf{F}\|t(f(t)\| = j\frac{d}{d\omega}\mathbf{F}(\omega) \tag{2}$$

**Problem 5.52 :**

**Given:** Let the Fourier transform of $f(t)$ be

$$\mathbf{F}(\omega) = \frac{1}{A + j\omega} e^{-j\omega} + B \tag{3}$$

**Find:** Determine the transforms of the following signals (set $A = 2$ and $B = 1$)

a. $f(\frac{5}{8}t)$

b. $f(t)\cos(At)$

**Problem 5.53 :**

**Given:** Let the Fourier transform of $f(t)$ be

$$\mathbf{F}(\omega) = \frac{A}{(B + j\omega)} \tag{4}$$

**Find:**

a. $f(3t - 2)$

b. $tf(t)$

**Problem 5.55 :**

**Given:**The waveform

$$\frac{\sin(20\pi t)}{\pi t}\frac{\sin(10\pi t)}{\pi t} \tag{5}$$

**Find:** Show that the spectrum of the above is zero for $\|\omega\| > 30\pi$.

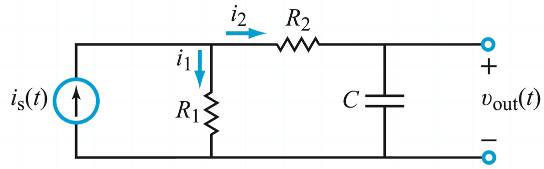


Figure 1: Fig. P5.23

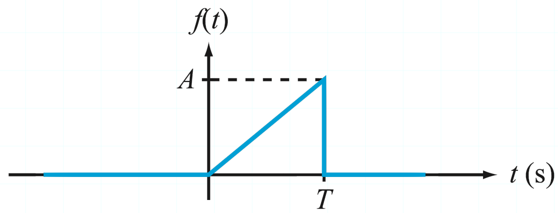


Figure 2: Fig. P5.39

**Problem 5.68 :**

**Given:** The circuit in Figure P5.23 and the waveform in Figure P5.39

**Find:**

a. Derive the expression for $v_{out}(t)$ using Fourier analysis.

b. Plot $v_{out}(t)$ using $A = 5\ V$, $T = 3\ ms$, $R_1 = 500\ \Omega$, $R_2 = 2\ k\Omega$, and $C = 0.33\ \mu F$.

c. Repeat part (b) with $C = 0.33\ mF$ and comment on the results

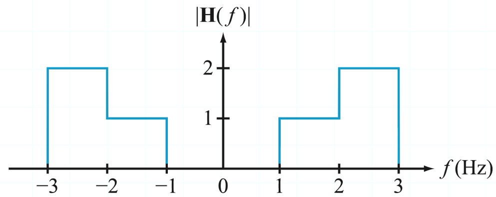


Figure 3: Figure P6.28

**Problem 6.28 :**

**Given:** The figure P6.28

**Find:** Derive the impulse response of a system characterized by the frequency response shown in Fig. P6.28. Express your answer in terms of three sinc functions.

**Problem 6.57 :**

**Given:** In World War II, voice radio scramblers used modulation schemes to distort a signal so that enemy forces could not understand it unless it was demodulated properly. In one scheme, a signal $x(t)$, bandlimited to $4\ kHz$, is modulated to generate an output signal

$$y(t) = [2x(t)\cos(8000\pi t)] * \left[\frac{\sin(8000\pi t)}{\pi t}\right] \tag{6}$$

**Find:**

a. Plot the range of the spectrum y(t).

b. Describe why the scrambled singal's spectrum is "distorted."

c. Show that $x(t)$ can be recovered from $y(t)$ using

$$x(t) = [2y(t)\cos(8000\pi t)] * \left[\frac{\sin(8000\pi t)}{\pi t}\right] \tag{7}$$

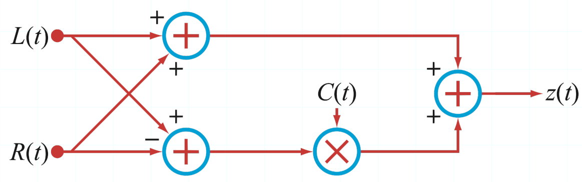


Figure 4: Figure P6.59

**Problem 6.59 :**

**Given:** FM stereo signals are formed using the system shown in Fig. P6.59, where $L(t)$ is the left speaker signal and $R(t)$ is the right speaker signal. Asssume both singls are bandlimitied to 15 $kHz$. Also the signal $C(t)$ is a 38 $kHz$ sinusoidal carrier given by $C(t) = 2\cos(76000\pi t)$.

**Find:** Sketch the spectrum of $z(t)$.