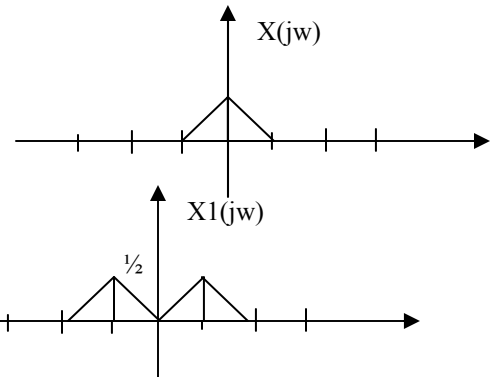


Problem:

Determine the signal produced if the following sequence of operations is performed on a signal $x(t)$ that is bandlimited to w_m (i.e., $X(jw) = 0$ for $|w| > w_m$). Suppose that $X(jw)$ is as shown in the figure and has amplitude 1. What is the amplitude of the output signal relative to $X(jw)$?

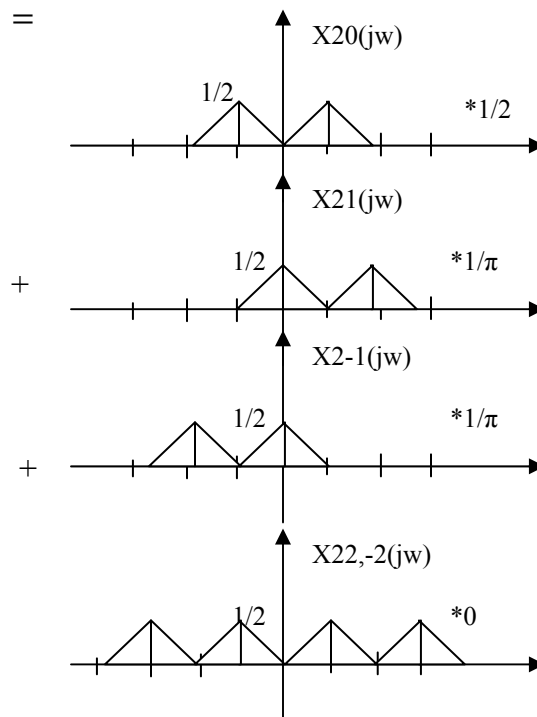
1. Modulation with a cosine with period $T = 2\pi/w_m$.
2. Modulation with a square wave with period $T = 2\pi/w_m$ and 50% duty cycle, i.e., $s(t) = 1$ for $|t| < T/4$.
4. Lowpass filtering with an ideal filter $H(jw) = 1$ for $|w| < w_m$.



$$1. X_1(j\omega) = \frac{1}{2\pi} \pi [\delta(\omega - \omega_m) + \delta(\omega + \omega_m)] * X(j\omega) =$$

$$2. S(j\omega) = F\{s(t)\} = \sum_{k \neq 0} \frac{2 \sin(\frac{k\pi}{2})}{k} \delta(\omega - k\omega_m) + \pi \delta(\omega); \left(a_0 = 1/2 \Rightarrow c_0 = \pi\right)$$

$$X_2(j\omega) = \frac{1}{2\pi} S(j\omega) * X_1(j\omega) =$$



This is rather complicated to add so we filter first and then add the filter outputs

$$4. X_4(j\omega) = H(j\omega) * X_2(j\omega) =$$

Amplitude = $1/\pi$ at $w = 0$, $1/4$ at $w = w_m$.

