ECE 351 DSP: Practice Problems 4

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1) Consider a continuous time signal carrying information in the bands 0-10 Khz and 15-20 KHz. Choose a sampling frequency F_s and the number of observed samples L such that the following hold.

   - There is no aliasing from the main lobes (i.e., the region between the first zero crossings of the frequency spectrum of the signals truncated to L samples) of the frequencies in both the bands.

   - One band of frequencies should be resolvable from the other, i.e., each frequency band starts or end beyond the extent of the main lobe of the other.

2) Let $x[n] = [1, 2, 1, 2, 1]$. Suppose you take the samples $X(0), X(\frac{\pi}{2}), X(\pi), X(\frac{3\pi}{2})$ from $X(\omega)$, and take their 4-point IDFT to obtain the new signal $\tilde{x}[n]$. Find $\tilde{x}[n]$.

3) Consider a system with impulse response $h[n] = [1, 2, 3, 4, x]$ and an input $x[n] = \sum_{k=-\infty}^{\infty} \delta[n - 4k]$. Let $y[n]$ be the system output, and we truncate $y[n]$ to 4 samples, i.e., we only take $y[0], y[1], y[2], y[3]$ and drop the rest. If the 4-point DFT yields $Y(1) = 11$, find x.

ANSWERS

1) $L = 10, F_s = 50$ KHz.

2) $\tilde{x}[n] = [2, 2, 1, 2]$.

3) $x = 1$.