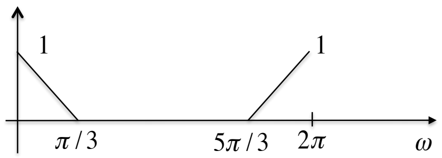
Homework 2 due 10/7 in class

1. (10pt) Let $x[n] = \delta[n-1] + \delta[n+1]$.
   (a) Determine $X(e^{j\omega})$. (Simplify the expression as much as possible)
   (b) Plot $|X(e^{j\omega})|$ and $\angle X(e^{j\omega})$.

2. (15pt) Let $X(e^{j\omega})$ be as given in the following figure.



   (a) Let $y[n] = x[n-2]$. Plot $|Y(e^{j\omega})|$ and $\angle Y(e^{j\omega})$. (Hint: time-shifting property)
   (b) Let $y[n] = x[n]e^{jn\pi}$. Plot $|Y(e^{j\omega})|$ and $\angle Y(e^{j\omega})$. (Hint: frequency-shifting property] Determine $y[n]$ in terms of $x[n]$.

3. (15pt) Let $h[n]$ be the impulse response of an eight-point moving average system.
   (a) Determine $H(e^{j\omega})$. Plot $|H(e^{j\omega})|$ and $\angle H(e^{j\omega})$.
   (b) Determine the output when the input of the system is $x[n] = e^{j\pi n/5}$ and when $x[n] = \cos(\pi n/5)$.
   (c) Let $x[n] = h[n]e^{j\pi n/3}$. Determine $X(e^{j\omega})$. (Hint: modulation or windowing theorem)
   (d) Suppose the input of the system is $x[n] = e^{j\omega_0 n}$ for some ω_0 and the output $y[n] = 0$. Determine ω_0.

4. (20pt) MATLAB Let $x[n]$ be a sequence that is nonzero for $M_1 \leq n \leq M_2$. Write a Matlab code to compute $X(e^{j\omega})$ for a given ω.

   Note: All Matlab assignments should be accompanied by observations, or comments on why the plots are reasonable. Unexplained plots are not given credits.

   (a) Let $h[n] = 1/8(u[n] - u[n-8])$. Compute $H(e^{j\omega_k})$, where $\omega_k = 2\pi k/N$ for $k = 0, 1, \cdots, N-1$ and $N = 20$. Plot $|H(e^{j\omega_k})|$ and $\angle H(e^{j\omega_k})$ as a function of k. Comment on difference between the Matlab plots and what you have in 3(a).
   (b) Let $x[n] = e^{j\pi n/3}$, for $n = 0, 1, \cdots, 7$. Compute $X(e^{j\omega_k})$, where $\omega_k = 2\pi k/N$ for $k = 0, 1, \cdots, N-1$ and $N = 128$. Use $|X(e^{j\omega_k})|$ and $\angle X(e^{j\omega_k})$ to plot $|X(e^{j\omega})|$ and $\angle X(e^{j\omega})$. Are the plots consistent with those in 3(c)?