EE 484

Homework 1

Due Monday, January 22, 2018

Work all 6 problems.

Problem 1. Explain the meaning of negative frequency.

Problem 2. Determine for each of the following whether or not the discrete-time system is linear, and/or time-invariant.

a. $y(n) = 2\cos[x(n) + 2]$.

b. $y(n) = x(n)$.

c. $y(n) = \log_{10}(|x(n)|), \quad x(n) \neq 0$.

d. $y(n) = x(n) + n$.

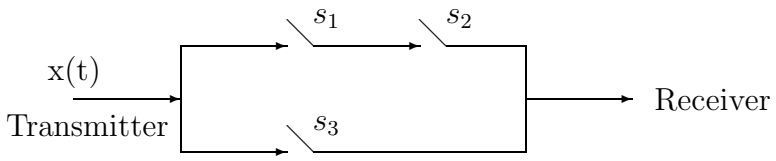
Problem 3. Compute the Fourier transform of the triangular pulse, $Tri(t)$, where

$$Tri(t) = \begin{cases} t+1, & -1 \leq t \leq 0, \\ 1-t, & 0 < t \leq 1, \\ 0, & elsewhere \end{cases}$$

and sketch a plot of its graph in the frequency domain. You should produce two plots (one for the magnitude of the Fourier transform and one for the phase). In the magnitude plot, clearly identify where the maximum height occurs and the value of the maximum height. Also, identify where the approximate zero-crossings occur (in doing this part you can ignore the contributions to the zero crossings due to that part of the signal whose energy is mostly concentrated away from the zero crossing you are identifying).

Hint: Think of the triangular pulse as the convolution of two rectangular pulses and use a Fourier transform property.

Problem 4. Consider the transmission of a signal as shown in the following diagram.



A signal is transmitted along two paths as shown. In the upper path there are two switches to pass through while in the lower path there is one switch to pass through. Each switch s_i operates independently and allows the signal to pass with probability p_i for $i = 1, 2, 3$. The signal transmission is successful if the signal $x(t)$ sent at the transmitter reaches the receiver along either or both paths. Find the probability that the transmission is successful if $p_1 = 1/2,\ p_2 = 1/3,\ p_3 = 1/4$.

Problem 5. Suppose the random variable X has mean 2 and variance 6. Let $Y = X^2 + 1$. Find the mean of Y.

Problem 6. Suppose the normal random variable X has mean 2 and variance 6. Let $Y = X^2 + 1$. Find the variance of Y.