ECE 376 - Homework #11

z-Transforms and Difital Filters - Due Monday, April 28th

z-Transforms

1) Assume X and Y are related by the following transfer function

$$Y = \left(\frac{2s+7}{(s^2+3s+15)}\right)X$$

a) What is the differential equation relating X and Y?

b) Find y(t) assuming

$$x(t) = 2 + 3\sin(4t)$$

2) Assume X and Y are related by the following transfer function

$$Y = \left(\frac{0.25(z+0.5)}{(z-0.8)(z-0.7)}\right)X$$

a) What is the difference equation relating X and Y?

b) Find y(t) assuming a sampling rate of T = 0.01 second

$$x(t) = 2 + 3\sin(4t)$$

c) Find y(t) assuming

$$x(t) = 3u(t)$$

Filters in the z-Plane

3) Assume G(s) is a low-pass filter with real poles:

$$G(s) = \left(\frac{500}{(s+1)(s+6)(s+12)}\right)$$

Design a digital filter, G(z), which has approximately the same gain vs. frequency as G(s). Assume a sampling rate of T = 0.01 second.

Plot the gain vs. frequency for both filters from 0 to 50 rad/sec.

4) Assume G(s) is the following band-pass filter:

$$G(s) = \left(\frac{500}{(s+10)(s^2+2s+400)}\right)$$

Design a digital filter, G(z), which has approximately the same gain vs. frequency as G(s). Assume a sampling rate of T = 0.01 second.

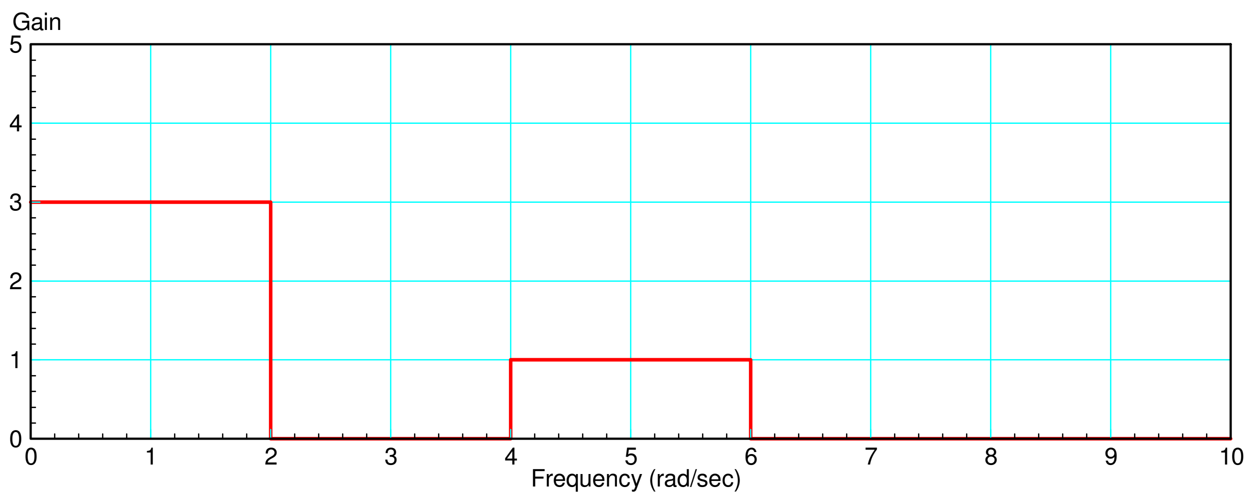
Plot the gain vs. frequency for both filters from 0 to 50 rad/sec.

5) Write a C program to implement the digital filter, G(z)

FIR Filters

6) Find the impulse response of a filter with the following gain vs. frequency:

- hint: Approximate the waveform by adding up ideal low-pass filters



7) Design a FIR filter to approximate this impulse reaponse. Include in your design

- The sampling rate
- The length of the window (10 seconds?)
- The impulse response of your FIR fitler.

8) Plot the gain vs. frequency of your filter