ECE 111 - Homework #10

ECE 343 Signals & Systems- Due Due 11am, Tuesday, November 1st

1) A filter has the following transfer function

$$Y = \left(\frac{2s+50}{s^2+4s+20} \right) X$$

1a) What is the differential equation relating X and Y?

1b) Find y(t) assuming $x(t) = 5$

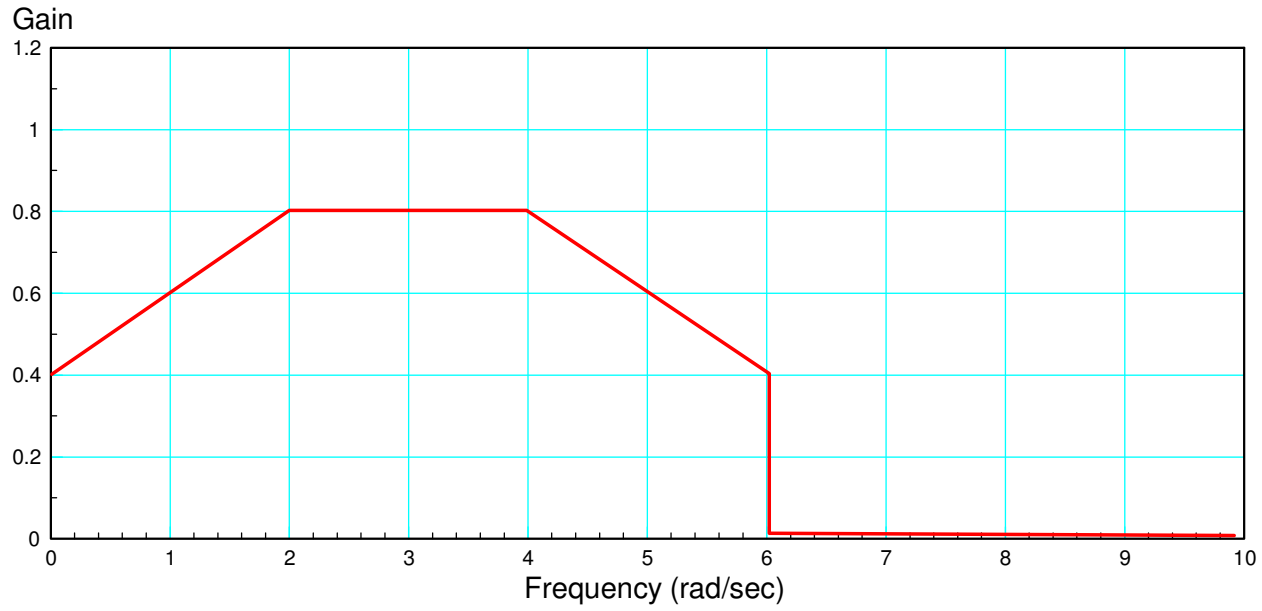
1c) Find y(t) assuming $x(t) = 5\sin(6t)$

2) Plot the gain vs. frequency for this filter from 0 to 50 rad/sec.

$$Y = \left(\frac{2s+50}{s^2+4s+20} \right) X$$

Problem 3-5) Design a filter of the following form so that the gain matches the graph below:

$$G(s) = \left(\frac{a}{(s^2+bs+c)(s^2+ds+e)(s^2+fs+g)} \right)$$



3) Write an m-file, cost.m, which

- Is passed an array, z, with each element representing (a, b, c, d, e, f, g)
- Computes the gain, G(s) for this value of (a, b, c, d, e, f, g)
- Computes the difference between the gain, G, and the target (above), and
- Returns the sum-squared error in the gain

4) Use your m-file to determine how 'good' the following filter is:

$$G(s) = \left(\frac{a}{\left(s^2+bs+c\right)\left(s^2+ds+e\right)\left(s^2+fs+g\right)} \right) = \left(\frac{70}{\left(s^2+2s+2\right)\left(s^2+2s+5\right)\left(s^2+2s+17\right)} \right)$$

5) Use fminsearch() to find the 'best' filter of the form

$$G(s) = \left(\frac{a}{\left(s^2+bs+c\right)\left(s^2+ds+e\right)\left(s^2+fs+g\right)} \right)$$

5a) Give the resulting (a, b, c, d, e, f, g)

5b) Give the resulting filter, and

5c) Plot the 'optimal' filter's gain vs. frequency