HW #8, due Thursday December 4, 2007 at 11:30AM

1. (25 pts) For each of the following four transfer functions, answer the following questions with coherent reasons and without using MATLAB to plot the root-loci:

a. Is the transfer function stable?

b. What is the relative degree?

c. Is the transfer function minimum phase?

d. What are the real branches of the root-locus plot?

e. How many branches go to infinity?

HW #8 p.2

#1 (cont)

$$g_1(s) = 1/s(s+1)(s+4)$$

$$g_2(s) = 1/(s+1)(s+2-j)(s+2+j)$$

$$g_3(s) = (s+2)/(s+1)(s+3-j)(s+3+j)$$

$$g_4(s) = 1/s(s+1)(s+3)(s+4)$$

#2. (20 pts.) Use MatLab to draw each of the root-locus plots in #1.

3. Take the first two digits of your SSN, multiply them and set c = last digit +2.

3(a). Compute the steady-state response of the system with transfer function g(s) = (s-1)/(s+1) for the driving signal R(t) = sin(ct) (10pts.)

3(b). Using MATLAB draw the Bode plot of g(s). (When did this the logs of the magnitudes were too small to get a good plot. So I scaled the problem by getting the Bode plots of 100 g(s). If you do something like this, be sure to explain what these Bode plots means for the Bode plot of g(s). Hint: one of them is unchanged.) (5pts.)

3(c). Interpret your answer to 3(a) using the Bode magnitude and phase plots in 3(b). (5pts.)

3(d) Design a 1st order stable cascade controller k(s) so that the steady state response of the feedforward system g(s)k(s) to the input R = sin(ct) *is* sin(ct)

(10 pts.)

(Hint: Design a stable $k(s) = K(s+a)/(s+b)$ so that $|k(jc)| = 1/|g(jc)|$ and so that

$$\angle\, k(jc) = -\angle\, g(jc)$$

4. Problem 6.14 in the text book on page 200,
   part (a) (10 points),
   part (c) (5 points)