UC Berkeley

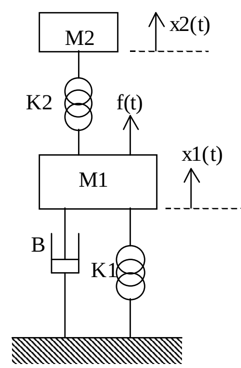
EE128 Homework #3

Due on 9/29/04

(1) The figure on the right depicts the structure of a vibration absorber.

(1.a) Find the transfer function from the excitation f(t) to x1(t).

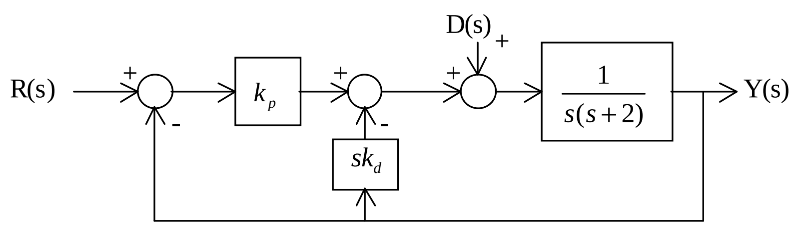
(1.b) Let M1=100, M2=20, k1=10000, B=200, and K2=100. Plot the frequency response (both magnitude and phase) of the transfer function found in (1.a).



(2) Textbook problem 3.40 (c)

(3) Textbook problem 3.41. No need to verify your answer using Matlab.

(4) Determine the value of k_p and k_d so that the system has 5% overshoot and the DC gain from D(s) to Y(s) is less than 0.02. (Hint: find the DC gain first.)

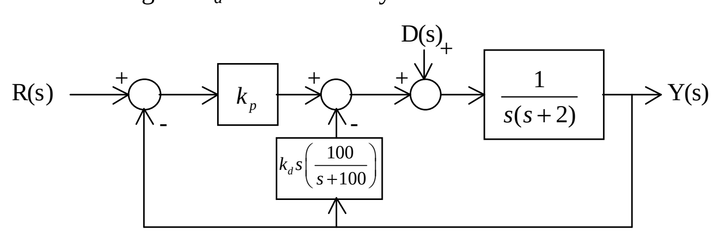


(5) For the system in (4), find the range of k_p and k_d such that the system is stable.

(6) Consider the following feedback system where the derivative term includes a low pass filter. This low pass filter represents the 'band limited' property of a practical 'differentiator'. In an ideal PD controller (such as the one in (4)), k_p can be increased arbitrarily large (for arbitrary fast response and high disturbance rejection) while the system is kept well damped by using a sufficiently large k_d.

(6.a) Let k_p =100, find the value of k_d such that the system has no overshoot (if such a value exist). You may use Matlab for this problem.

(6.b) Let k_p =100, what is the range of k_d in which the system is stable?



(7.a) Prove that the DC gain from D(s) to Y(s) is zero for the following system.

(7.b) Determine the values of k_p, k_d, and k_i such that the closed loop system's 3db bandwidth is about 100r/s, overshoot is less than 5%, and the tracking error E(t) due to a unit step disturbance converges to zero as quickly as possible. You may use Matlab for this problem. Turn in your step response plot.