1 a)

Given that

Then,

[Fill in values of and from previous lab]

From Lab 1,

1 b)



If the PD controlled system is simplified, the resulting transfer function is

[I have some handwritten block diagram simplifications and calculations to get that result. I can make them neater if needed]

Since, for an ideal 2nd order system, the transfer function is:

Then relating that to the closed loop system above,

[We can use the and values from our previous lab along with m and b to find the values of and ]

From the design specifications:

In addition, recalling the values from 1 a)

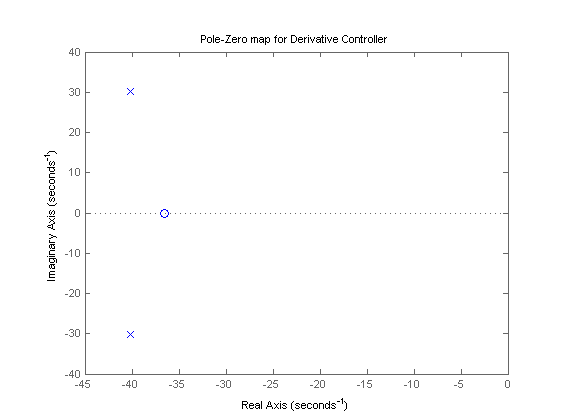
1 c)

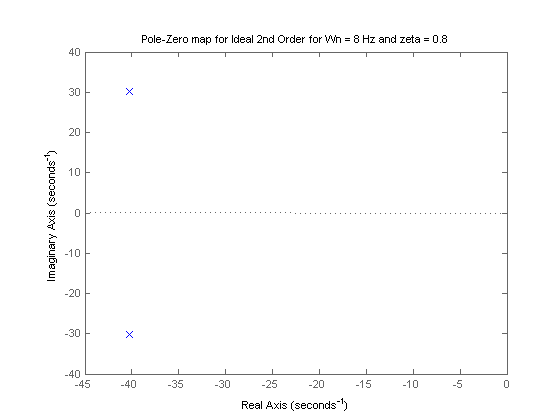
The ideal system response and the theoretical response of the PD-controlled system are presented below:





Note that the D-controlled system has an additional left-hand plane pole. This increases the overshoot as can be seen in the graphs. Since zeta = 0.8 is fairly close to 1, the ideal system has very little overshoot, with the system response fairly similar to that of a critically damped system. The addition of the additional zero to allow for D-control creates a much higher degree of overshoot. The pole-zero maps presented below show that the systems have identical pole locations, but the derivative controlled system has an additional zero at Kp / Kd = 36.58.





1 e) Plotting pd controller (square wave)

1f)