1) Problem 8.1 in text

2) Problem 8.2 in text

3) Problem 8.4 in text

4) Consider the two-mass-spring system discussed in class that has a single input on the first mass. The transfer function from input to mass 1 position is:

\[ \frac{X_1(s)}{U(s)} = \frac{s^2 + 50}{s^2(s^2 + 100)} \]

If we are concerned about controlling the velocity of mass 1, rather than the position, then the relevant transfer function becomes:

\[ \frac{V_1(s)}{U(s)} = \frac{s^2 + 50}{s(s^2 + 100)} \]

a) Transform the system model into a control canonical state space model.

b) Access the controllability and observability of the system.

c) Plot the response of the system to a step input.

d) Using state feedback and pole placement, improve the response of the system.

e) Suppose that only two of the three states can be measured. Decide which two you to measure and then use an observer to calculate the third state. Using the two measured states and the calculated state in your state feedback controller. How is the performance changed by using an observer?

5) Problem 8.10 in text