Module 09:
§12.1–3

§12.2

1. For the system in Figure 1, find a state-space representation of the closed-loop system with state-variable feedback if the position of mass 2 is the output. Also find the matrix, $\lambda I - (A - BK)$.

2. For the plant

$$G(s) = \frac{100(s+10)}{s(s+3)(s+12)}$$

design the phase-variable feedback gains to yield 5% overshoot and a peak time of 0.3 second.

3. Given the following open-loop plant,

$$G(s) = \frac{20}{(s+2)(s+4)(s+8)}$$

design a controller to yield a 15% overshoot and a 0.75 second settling time. Place the third pole 10 times as far from the imaginary axis as the dominant pole pair.

4. Find the phase-variable gains that will yield 5% overshoot and 0.2 second settling time for the system in Figure 2, using the following impedance values: $K = 30$, $D = 12$, and $M = 2$.

§12.3

1. Determine the controllability of a system with the following state equation.

$$\dot{\bar{x}} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \bar{x} + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u$$

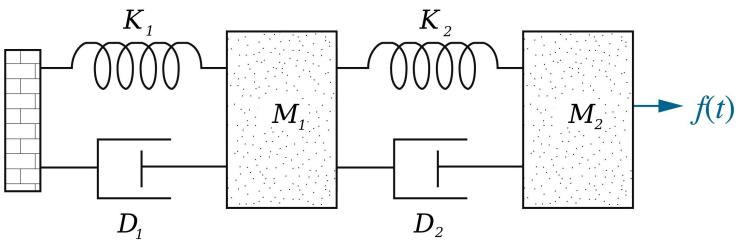

Figure 1: Two DoF SMD system

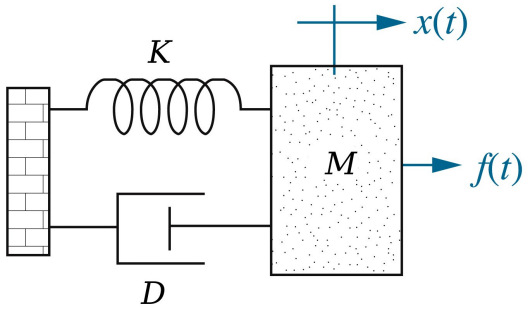

Figure 2: One DoF SMD system

2. Find the controllability matrix, C_M, and its rank for the system pictured below.

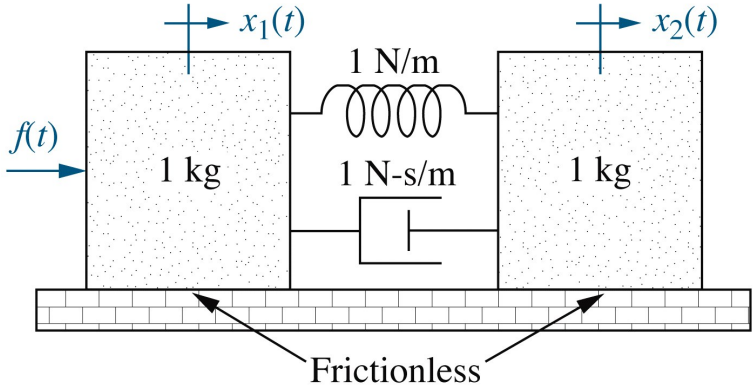

Figure P2.10

3. Find the controllability matrix, C_M, and its rank for the system pictured below.

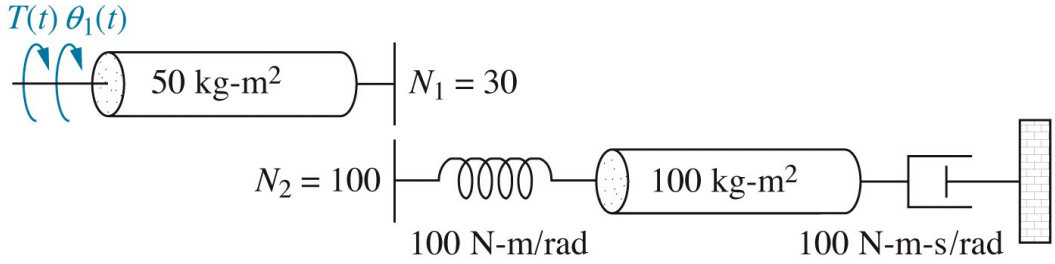

Figure P3.6