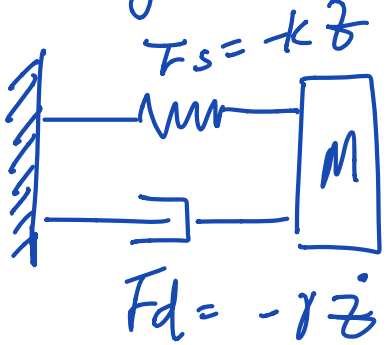
Total 4o pt

Consider the spring-damper system shown in Fig 1



$z(t)$: position of the mass

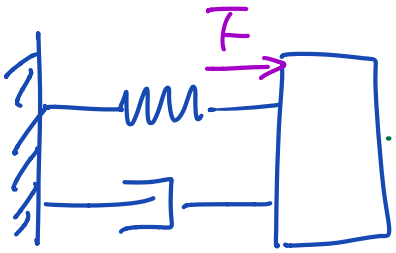
$\dot{z}(t)$: velocity of the mass.

The dynamical equation of the system is.

$$m\ddot{z} + \gamma\dot{z} + kz = 0$$

Question (1): write down the state space form. (2pt)

Now, let's apply force:



Question (2): write down the dynamic equation of the system, and express it in the state-space form. (3pt)

Hint: $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} z \\ \dot{z} \end{bmatrix}$ $\quad u = F$

(3) Given

(5pt)

$$K = 2, \quad m = 5, \quad g = 1$$

is the system controllable?

(4) Define the output

(15pt)

$$y = Cx \quad \text{with} \quad C = [1 \quad 0]$$

(That is, the output is the position of the mass)

Let the origin $\vec{x} = 0$ be the equilibrium of the system when no external force F is applied

Design a set-point tracking controller so that the system stabilize to $y_r = 5$. with zero velocity.

(5) implement the set point tracking controller in Matlab. Print out the state trajectories in your output file.

(15pt)

(Try starting with different initial position and velocity)