Problem 1 (CDS 101, CDS 110): (15 points) Do problem 6.7 in Chapter 6 of FBS-2e.

Problem 2 (CDS 101, CDS 110): (25 points)

The goal of this problem is to explore the time domain behavior of a general 2nd-order system of the form:
\[ \ddot{x} + 2\zeta\omega_0\dot{x} + \omega_0^2 x = \omega_0^2 u. \]
we will consider the case \( \zeta < 1 \).

Part (a): Convert the dynamics system to first order form

Part (b): Determine and plot the impulse response of this system for the case where \( C = [1 \ 0] \).

Part (c): Find the response of this system to a unit step input, assuming that \( x(0) = \dot{x}(0) = 0 \).

Part (d): Determine the time until the first peak in response. Knowing this time, derive an expression for the peak overshoot.

Part (e): Estimate the rise time, which is the time it takes from the onset of the step input until the time that the response first reaches a magnitude of one (the amplitude of the step input).

Problem 3 (CDS 110): (10 points) Do problem 6.5 in Chapter 6 of FBS-2e.

Problem 4 (CDS 110): (20 points) Do problem 6.8 in Chapter 6 of FBS-2e.