

Homework 5, ECE 1675/2570 Robot Control, Spring 2022
(No need to turn in)

Problem 1. Please read Lecture 4 of ECE 2646.

Problem 2. Consider a pendulum with frequency ω_0 and a state-space description given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\omega_0^2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u.$$

Please find the control law that places the closed-loop poles of the system at $-2\omega_0$. In other words, you wish to double the natural frequency and increase the damping ratio from 0 to 1.

Problem 3. Consider a system represented by

$$\dot{x}_1 = -2x_1 + u \text{ and } \dot{x}_2 = -3x_2 + kx_1$$

where k is a constant. Please determine the condition on k for controllability.