**EE 301P: Control Systems Laboratory**
**Lab Exercise 8**

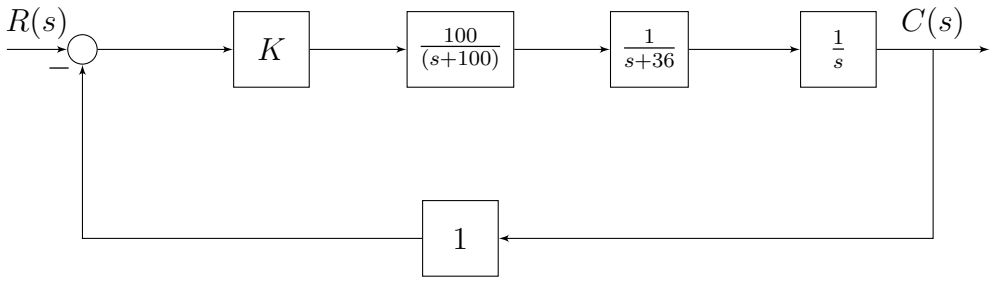
*Lab session*: November 3, 2023 *Report due*: November 10, 2023

# 1 Objective

To tune system gain using frequency response methods.

# 2 Pre-lab exercise

The following block diagram represents a position control system, the input signal is the desired position, and the output signal is the actual shaft position. Here,




$R(s)$ represents the desired shaft position, and $C(s)$ is the achieved shaft position. The gain $K$ represents a pre-amplfier, and the two blocks that follow represent the dynamics of the power amplifier and the motor. The motor produces a signal that is representative of the shaft velocity, which is fed into the integrator block to obtain the shaft position. Use only frequency response methods for the following.

a) Assume that $K = 1$, and draw the Bode plots for the system.

b) Is the system stable/conditionally stable? If so, for what values of $K$ would the system be stable?

# 3 Lab exercise

a) Verify the Bode plots and system stability using MATLAB/Simulink.

b) Find the value of gain $K$ that would yield a phase margin of 40°. Find the transient response characteristics of the system for this value of $K$. Verify using MATLAB/Simulink.

c) Find the value of gain $K$ that would yield a peak overshoot of 9.5% in the transient response for a step input. Verify using MATLAB/Simulink.

# 4 Deliverables

a) Lab report, necessarily containing

   (a) Hand-drawn Bode plots, and calculation to derive value of $K$ for system stability.

   (b) Calculations required for finding $K$ for the given specifications.

   (c) Bode plots obtained on MATLAB.

b) MATLAB Code/ Simulink model.