EE 450 Homework 3

Due: April 21, 2025

Problem 1

Consider the system shown in Figure 1.

(i) What is the system type?

(ii) What is the value of the appropriate static error constant?

(iii) What is the steady-state error for a unit step input?

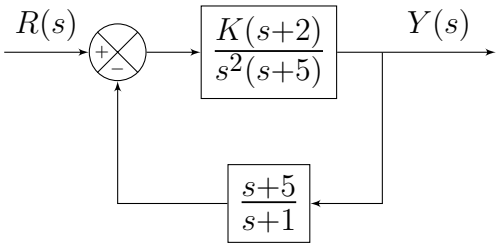

Figure 1: Block diagram of a system

Problem 2

For each second order closed-loop system with the following performance characteristics, find the closed-loop bandwith, resonance peak, phase margin, overshoot:

a) $\zeta = 0.2$, $t_s = 3$ seconds

b) $\zeta = 0.2$, $t_p = 3$ seconds

c) $t_s = 4$ seconds, $t_p = 2$ seconds

d) $\zeta = 0.3$, $t_r = 0.3$ seconds

Problem 3

Make all necessary calculations and plot on the semi-log paper (download from Moddle) the linear asymptotic magnitude and phase Bode plots for the following transfer function:

$$G(s) = \frac{40(s+7)}{s(s^2+2s+25)}.$$

(Use different semi-log papers for magnitude and phase. Plot the diagrams on semi-log papers with all details for full credit)

Problem 4

Calculate gain margin and phase margin of following transfer function:

$$G(s) = \frac{1000}{s(s+5)(s+20)}$$

(Do not use Bode diagrams)

Problem 5

Plot the Root Locus diagram for the closed-loop control system with open-loop transfer function $G(s)$ and feedback $H(s)$ as

$$G(s) = \frac{K}{s^3 + 6s^2 + 25s + 68}, \quad H(s) = 1.$$

(Plot the diagram on squared paper with all details for full credit)

Important!

- Late submissions are not accepted unless you have a valid excuse.
- Hand in your homework written on A4 paper.
- You should explain each step done in each of the problems.
- Academic dishonesty will not be tolerated. If your solution matches an online solution or matches a solution in somebody else's homework, not only do you receive a 0 grade but also the rules of the Ethic Committee would apply.