Laboratory 5: Steady-state and Transient Response

Problem 11:

We are given the following transfer functions

$$G_1(s) = \frac{(s+3.5)(s+4)}{(s+3)(s+10)} \qquad G_2(s) = \frac{s+8}{(s-3)(s+200)}$$
$$G_3(s) = -\frac{s-4}{(s+4)(s^2+3s+3)} \qquad G_4(s) = \frac{s+2}{(s+10)(s+20)}$$

a. Determine the dominant pole for each of the transfer functions. Justify your choice in each case!

b. Which of the transfer functions leads to undershoot in the step response?

c. Which of the transfer functions leads to overshoot in the step response?

d. Determine the final value of the step response for G_1, G_2, G_3 and G_4

e. Simulate the step responses of G_1, G_2, G_3 and G_4 and verify your results in **a.** to **c.**.

Problem 12:

We recall the transfer function of the modified vehicle suspension system with friction:

$$G(s) = \frac{K\,A_H}{m\,s^2 + \gamma\,s + c}$$

The parameter values are $m = 1000\,\text{kg}$, $c = 10\,000\,\text{N/cm}$, $g = 10\,\text{N/kg}$, $A_H = 15\,\text{cm}^2$, $K = 100\,\text{N/cm}^2/\text{V}$.

We look at two different values of γ.

a. Assume that $\gamma = 2\,000\text{N sec/m}$. What is the dominant pole of $G(s)$?

b. Assume that $\gamma = 20\,000\text{N sec/m}$. What is the dominant pole of $G(s)$?

c. Simplify $G(s)$ in **b.** by neglecting the mode that is not dominant. What is the type of the simplified transfer function?

d. Compare the step responses for the transfer functions in **b.** and **c.** by simulation.