Introduction to Control (034040)

tutorial 11

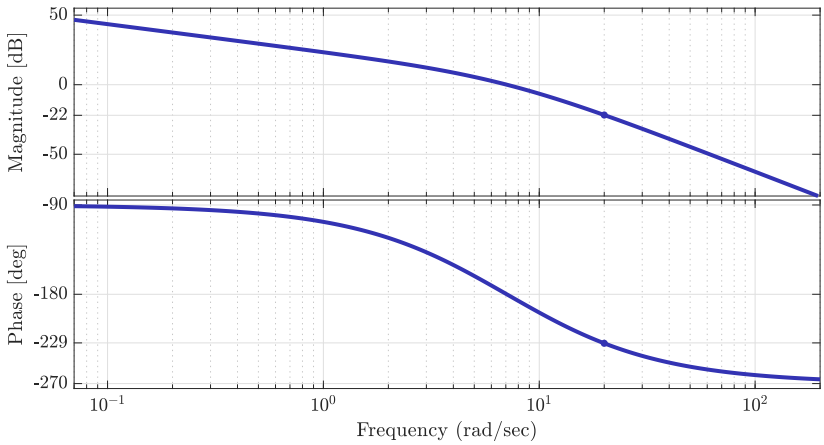

Fig. 1: Bode plot of $P(s)$ in Question 1

Question 1. Fig. 1 presents the Bode plot of

$$P(s) = \frac{750}{s(s+5)(s+10)}.$$

Design a stabilizing controller $C(s)$ in the unity-feedback configuration so that

1. closed-loop bandwidth $\omega_b \geq 20$ [rad/sec],
2. phase margin $\mu_{ph} \geq 45°$,
3. steady-state error for a step reference signal does not exceed 1% of the step height,
4. steady-state error for a step load disturbance does not exceed 1% of the step height.

Repeat it with the phase margin bound $\mu_{ph} \geq 35°$, explain differences.

Question 2 (self study)**.** Consider a DC motor like that in Lecture 11 controlled in the unity-feedback scheme. Assume that a loop delay of 1.5 [s] is also present in the loop, i.e. the plant transfer function is now

$$P(s) = \frac{1}{s(s+2)}\,\mathrm{e}^{-1.5s}.$$

Consider the following closed-loop specifications:

- zero steady-state error for a step in r
- zero steady-state error for a step in d
- phase margin $\mu_{ph} \geq 45°$.

Design stabilizing controllers C for these specifications under the following requirements on the crossover frequency:

1. $\omega_c = 0.05$ [rad/sec],
2. $\omega_c = 0.5$ [rad/sec],
3. $\omega_c = 1$ [rad/sec].