Control System: Homework 08 for Units 6A, 6B, 6C: Bode Plot

Assigned: May 14, 2021

Due: May 21, 2021 (11pm)

1. (Frequency response and Bode plot)

2. (a) Calculate the magnitude and phase of

$$G(s) = \frac{1}{s+5}$$

by hand for $\omega = 1, 2, 5, 10, 20, 50$, and 100 rad/sec.

(b) sketch the asymptotes for $G(s)$ according to the Bode plot rules, and compare these with your computed results from part (a).

For (a), you can use calculator to compute the exact numerical results.

In exam, we will provide the problem which can be easily calculated by pen.

Hence, you cannot use any calculators in exam.

2. (Bode Plot and Frequency Properties)

3. For the open-loop transfer functions of the unity feedback control systems. given below, sketch the Bode magnitude and phase plots. Find their gain margins, gain crossover frequencies, and phase crossover frequencies.

(a) $L(s) = \dfrac{10}{s\,[s+10]}$

(d) $L(s) = \dfrac{50}{s(0.5s+1)^2}$

Try to sketch the plots by hand-pen and, then use Matlab code to verify your results.

3. (Bode Plot and Timing Properties)

11. A normalized second-order system with a damping ratio $\zeta = 0.5$ and an additional zero is given by

$$G(s) = \frac{s/a + 1}{s^2 + s + 1}.$$

Use MATLAB to compare the M_p from the step response of the system for $a = 0.01, 0.1$, 1, 10, and 100 with the M_r from the frequency response of each case. Is there a correlation between M_r and M_p?