SEHS4653 Control System Analysis
Tutorial Questions (Part 3)

Bode Plot

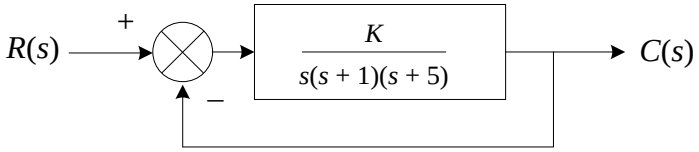
1. Plot the asymptotic and exact Bode diagrams of the open-loop transfer function,
$$G(s) = \frac{10(s+1)}{(s+2)(s+5)}.$$

2. Draw the exact Bode diagram for the following open-loop transfer function using a frequency range from 0.05 to 0.25 rad/s, in step of 0.05 rad/s.
$$G(s) = \frac{2}{(1+2s)(1+3s)(1+11s)^2}$$

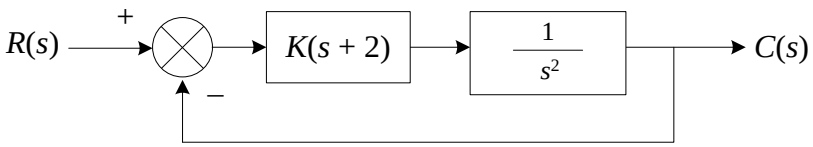
Gain and Phase Margin

3. Determine the value of K for the open-loop transfer function of a control system,
$$G(s) = \frac{K}{s(s+2)(s+10)}$$
such that the system may have
(a) a gain margin of 6 dB; and (b) a phase margin of 45° **analytically**.
(c) Repeat (a) and (b) **graphically** by using ω = 0.01, 0.04, 0.08, 0.1, 0.5, 0.8, 1, 5, 8, 10 and 20 rad/s.
(Ans: (a) K = 120.28; (b) K = 37.22; (c) 157.18 and 35.18)

4. Obtain the phase and gain margins of the system shown below for the two cases: (a) K = 10 and (b) K = 100 by plotting Bode Diagram. Which system is stable? (Ans: (a) Gain margin = 8.3 dB, phase margin = 26°; (b) Gain margin = –11 dB, phase margin = –19°)



5. Below shows a block diagram of a space vehicle control system. Determine the gain K such that the phase margin is 50°. (Ans: K = 1.826)



End of Tutorial Questions (Part 3)