ECE 388

Automatic Control

LAB 11

Lead Compensator

List of Equipment/Software

MATLAB, Simulink

TASK 1: Consider the plant given by :

$$G(s) = \frac{s+3}{(10+s)(s^2+2s+2)}$$

We want to design a lead compensator such that the steady-state error for reference steps is smaller than 0.1 and the phase margin is $70°(\phi_m)$. Follow the steps and find the controller:

$$C(s) = K\frac{1+Ts}{1+\alpha Ts}$$

a) Find the corner gain value K which satisfies that the steady-state error for reference steps is smaller than 0.1.

b) Draw the bode plot of $KG(s)$ and find the phase margin (ϕ'_m).

c) Determine required lead angle (α) :

$$\varphi = \phi_m - \phi'_m + 10$$

$$\alpha = \frac{1-\sin(\varphi)}{1+\sin(\varphi)}$$

d) Find the gain crossover frequency (w_α):

$$|KG(jw_\alpha)|_{dB} = -20\log(1/\sqrt{\alpha})$$

e) Write the controller with the last paramater T :

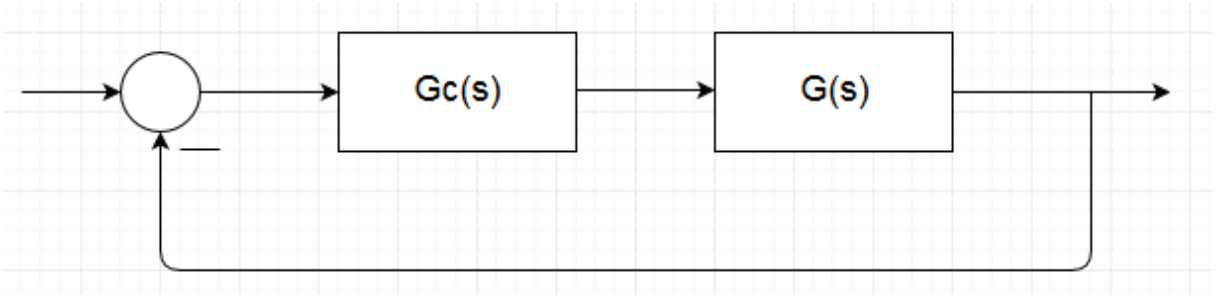
$$T = \frac{1}{w_\alpha\sqrt{\alpha}}$$

f) Draw the bode plot of $C(s)G(s)$ and check the phase margin (ϕ_m) is correct or not.

g) Simulate the closed loop with reference step and check the steady-state error.

h) Let say the gain K is given as $K = 20$. Check what is new phase margin and the steady-state error.

TASK 2: Consider the following feedback controlled system is given:



$$G(s) = \frac{1}{s-3}$$

Design a PID controller $G_c(s)$ which moves two poles of closed loop to -2.