Home Work #5

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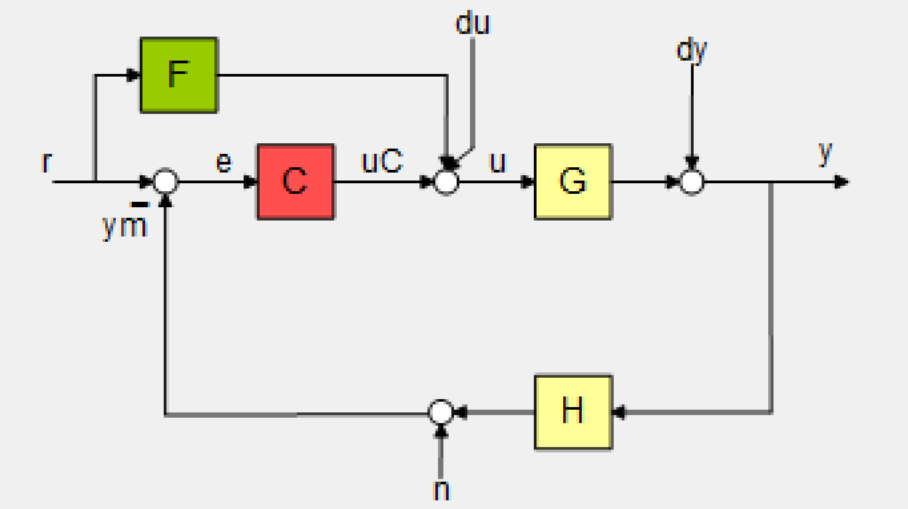
1 Question 1

System:

$$G(s) = \frac{s+1}{s^2 - 2s + 4}$$

System is NMP (Non Minimum Phase) because it have poles in right side and system is unstable.
Architector:

Figure 1: Architector of system in siso matlab toolbox

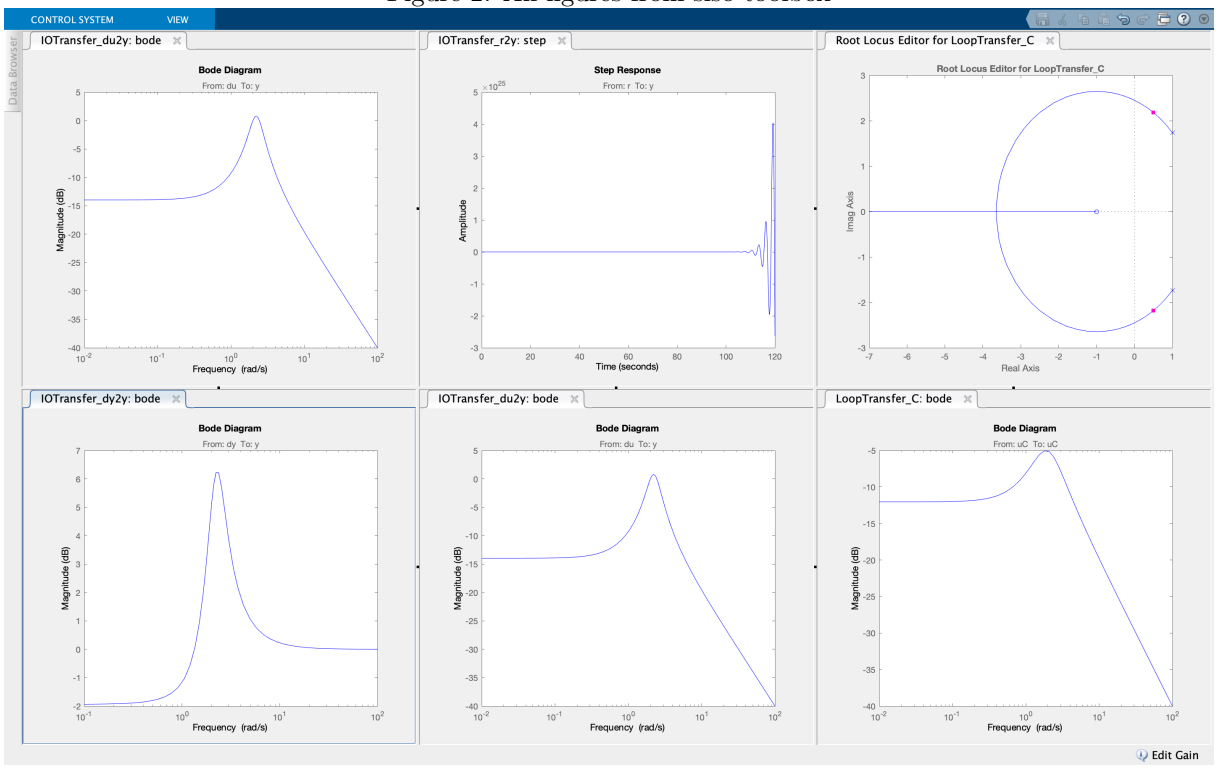


1.1 part a

In condition without controller from architector $C(s) = 1$ and $F(s) = 0$.

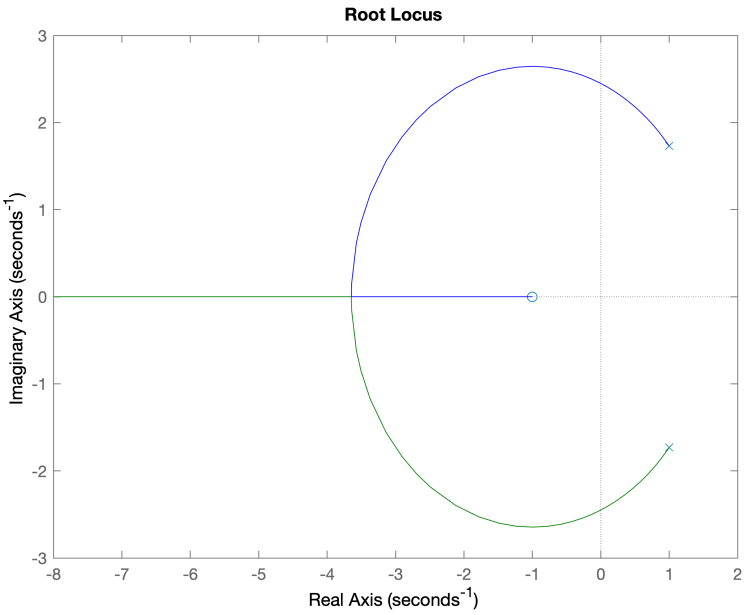
- all figures from siso toolbox

Figure 2: All figures from siso toolbox



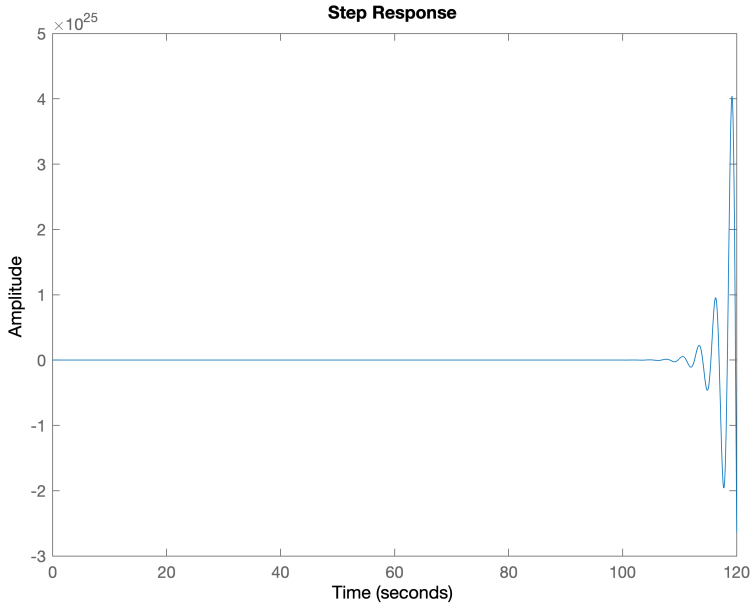
- root locus

Figure 3: root locus



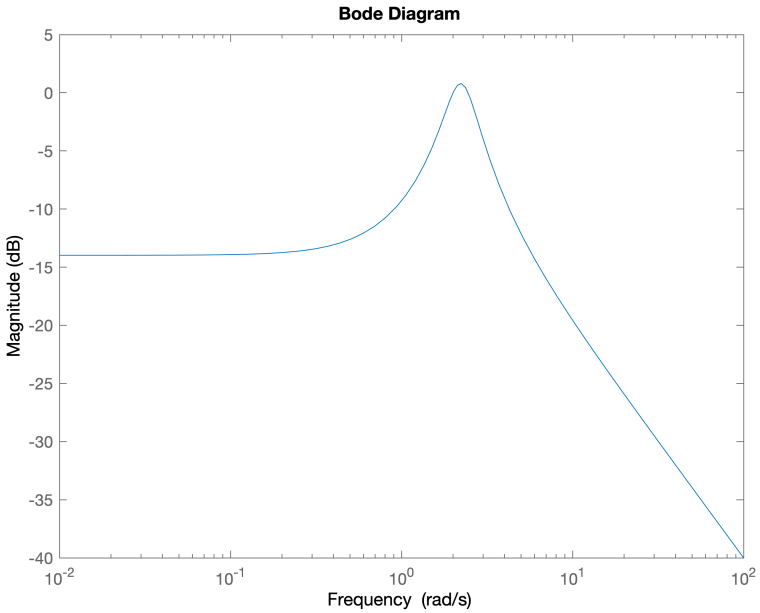
- step response for closeloop system

Figure 4: step response for closeloop system



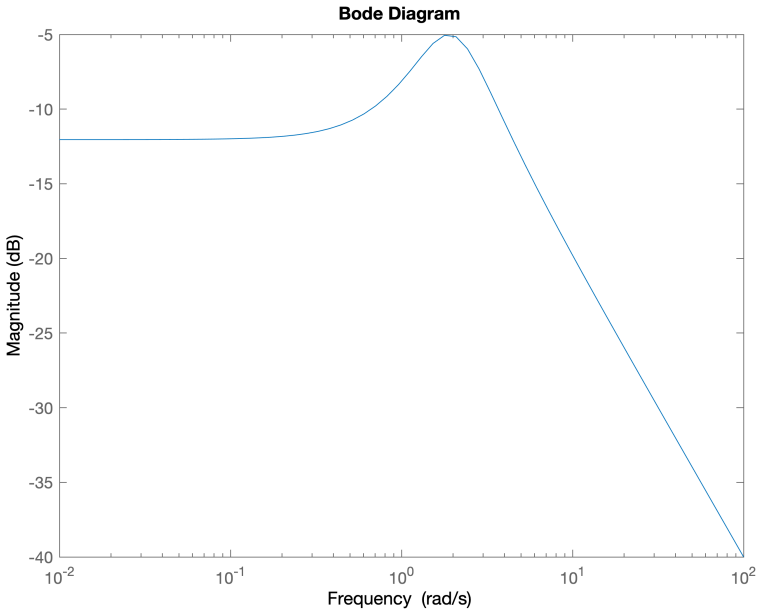
- closeloop bode (magnitude)

Figure 5: closeloop bode (magnitude)



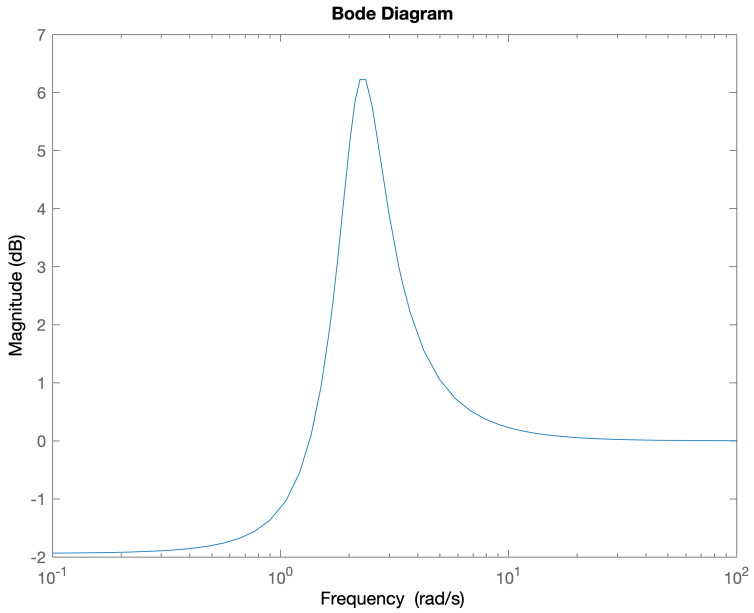
- openloop bode (magnitude)

Figure 6: openloop bode (magnitude)



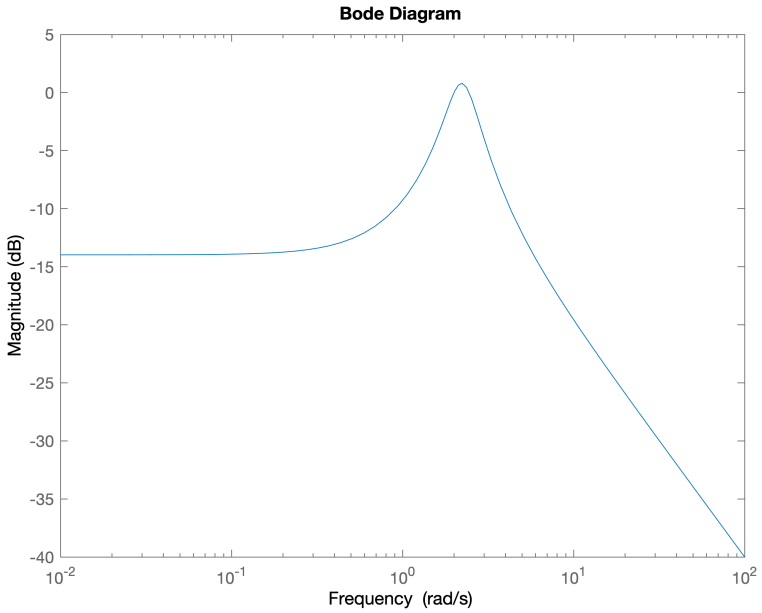
- sensitivity function

Figure 7: sensitivity function



- complementary sensitivity function

Figure 8: scomplementary sensitivity function



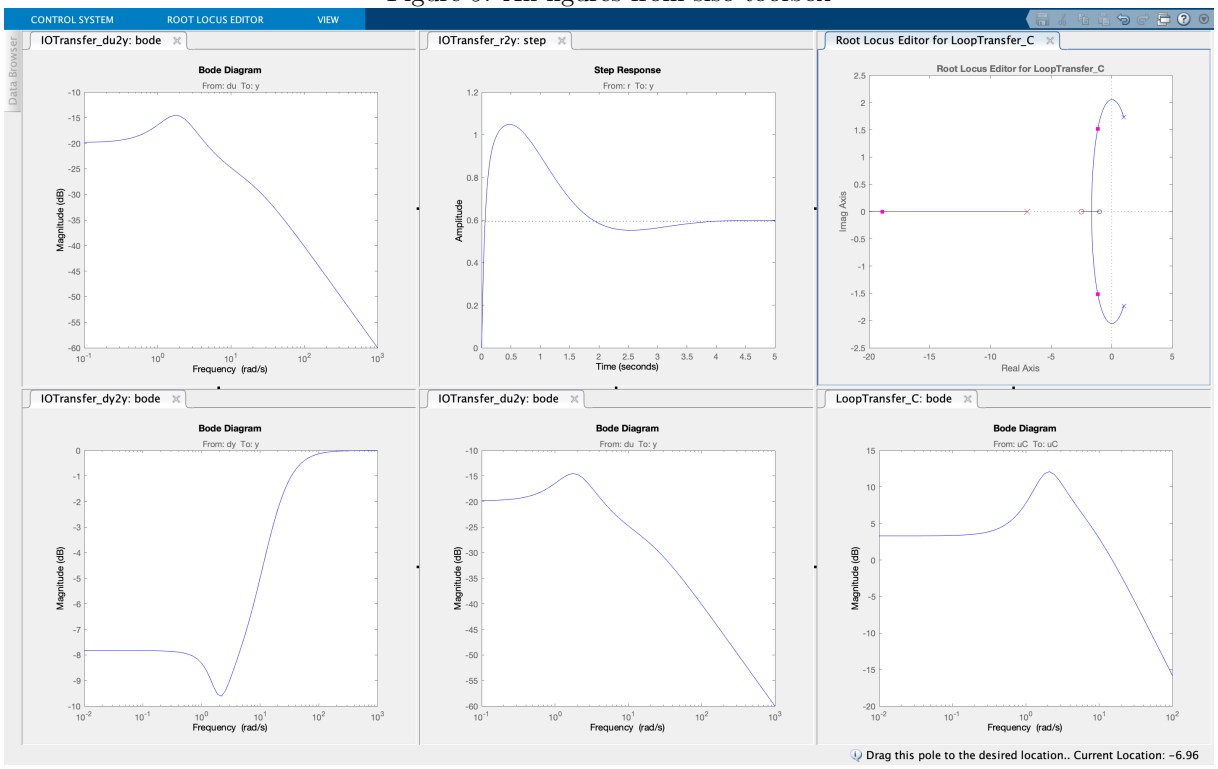
1.2 part b

We design a lead controller with siso tool box.

$$C(s) = \frac{16.231(s + 2.51)}{s + 6.963}$$

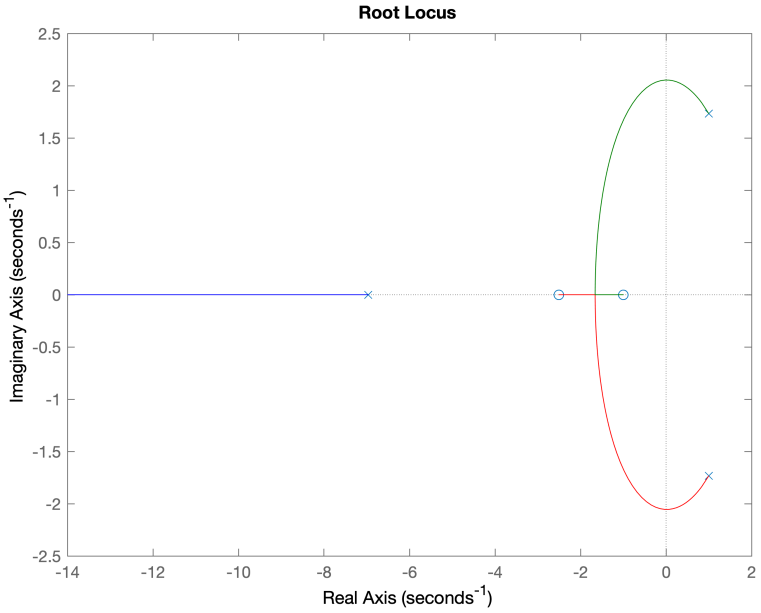
- all figures from siso toolbox

Figure 9: All figures from siso toolbox



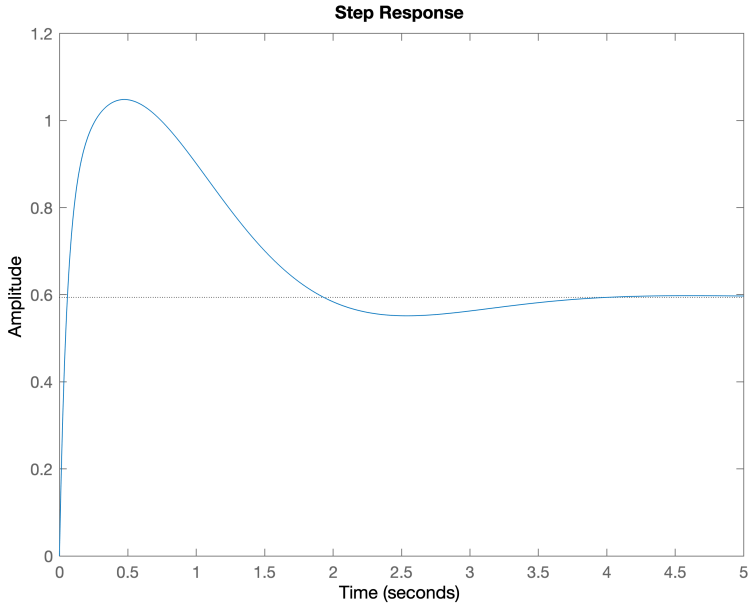
- root locus with controller

Figure 10: root locus



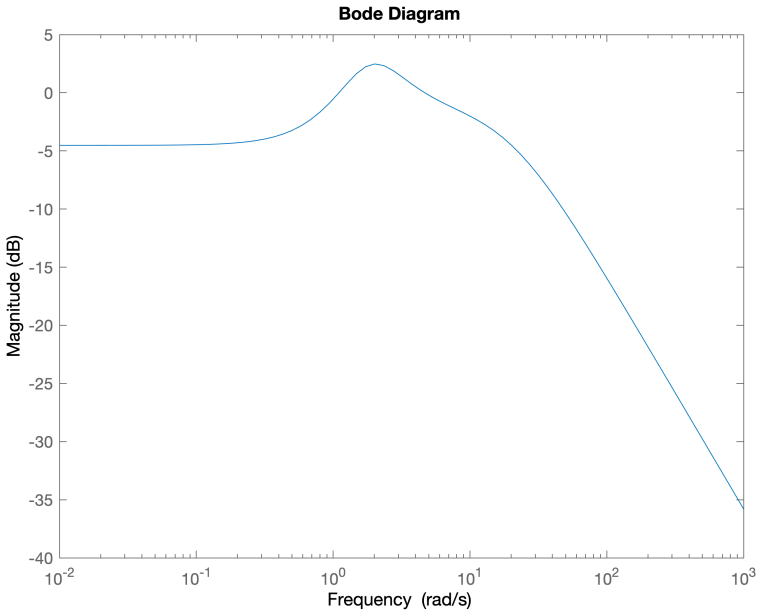
- step response for closeloop system with controller

Figure 11: step response for closeloop system



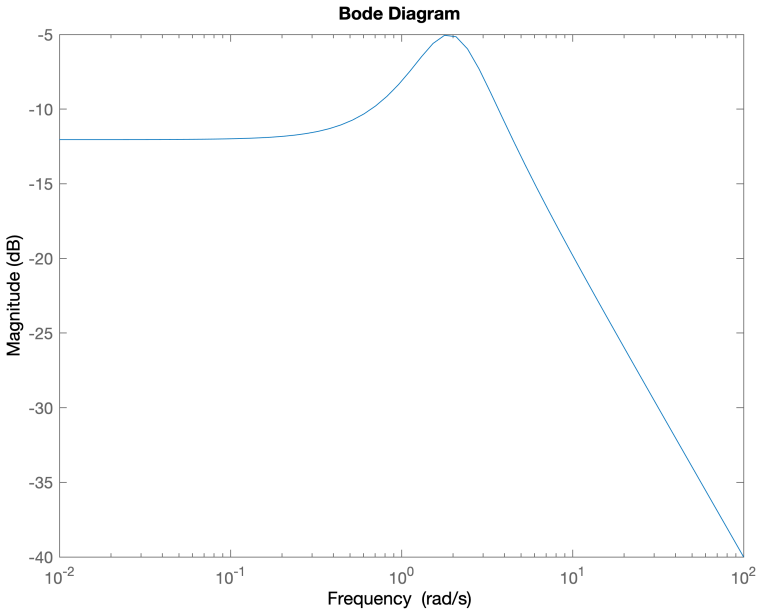
- closeloop bode (magnitude) with controller

Figure 12: closeloop bode (magnitude)



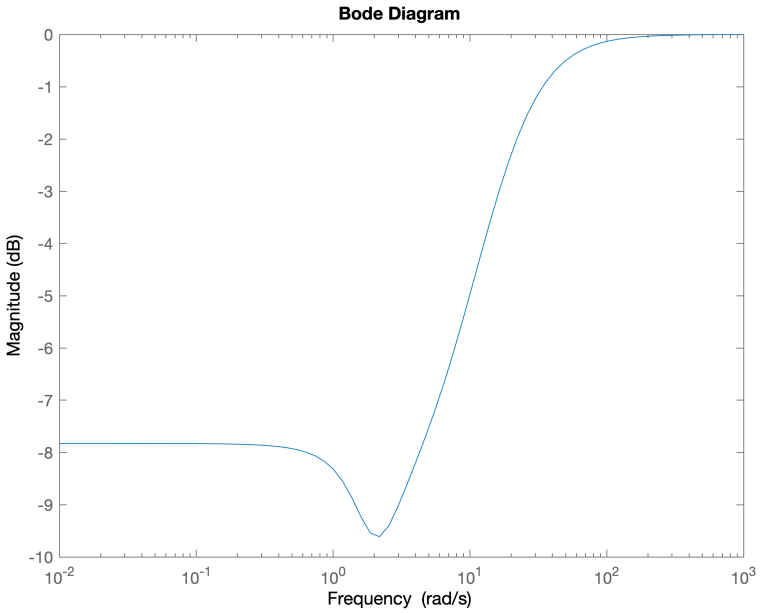
- openloop bode (magnitude) with controller

Figure 13: openloop bode (magnitude)



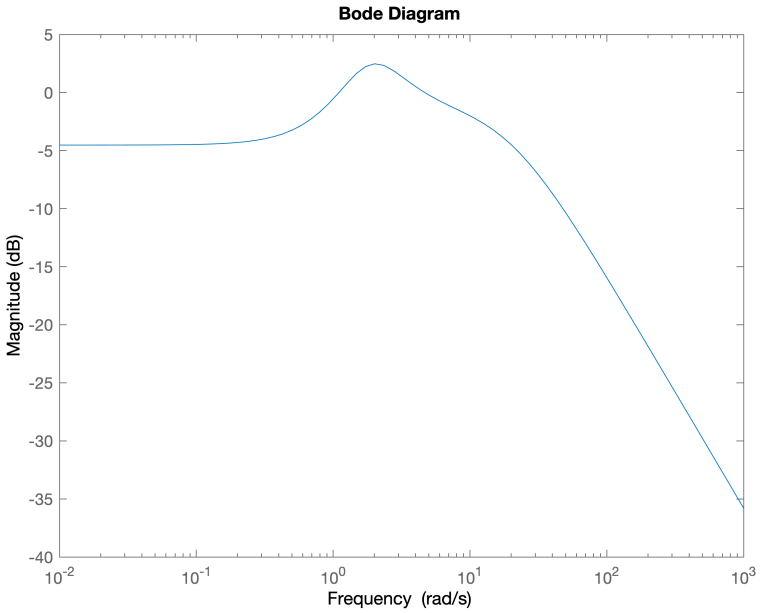
- sensitivity function with controller

Figure 14: sensitivity function



- complementary sensitivity function with controller

Figure 15: scomplementary sensitivity function



System is stable with controller and have a noise cancelation for frequancy after $100_{rad/\sec}$ and it have effect on system about -20_{dB}. System have very good disturbance rejection about $1_{rad/\sec}$ and have a good disturbance rejection about $10_{rad/\sec}$ and disturbance have effect on system about -5_{dB}.

In this question we don't know what is plant and actuator and how noise or disturbance effect on system and about what frequancy so we assume that noise is about more than $100_{rad/\sec}$ and disturbance is about $10_{rad/\sec}$ and-5_{dB} is a low effect and system work well.

No. System have staedy state error. we could increase gain in controller but it needed very high gaib controller and no actuator can do this so we can't make staedy state error zero with this requirements.

1.3 part c

Contents

List of Figures

List of Tables