Home Work #4

Ali BaniAsad 96108378

November 11, 2021
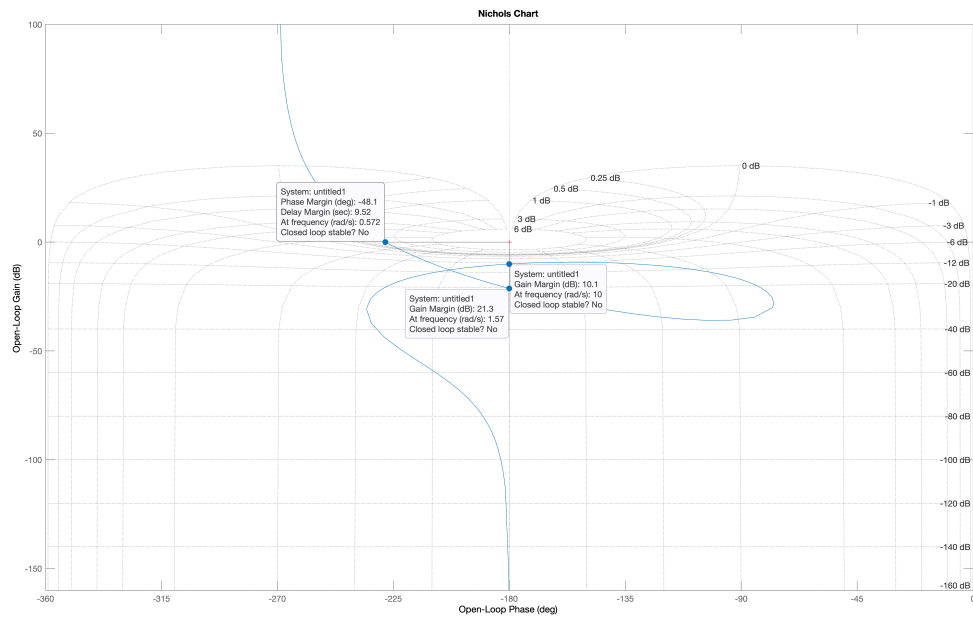
1   Question 1

System:

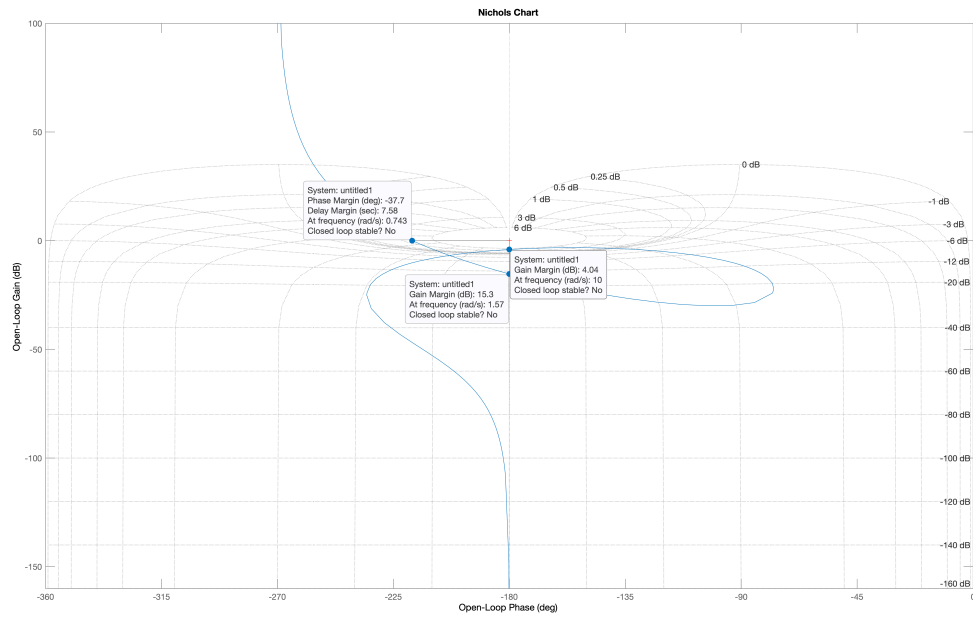$$G(s) = \frac{(s+1)(s+4)(s+8)}{s^3(s^2 + 0.2s + 100)}$$

1.1   part a

- $K = 0.5$

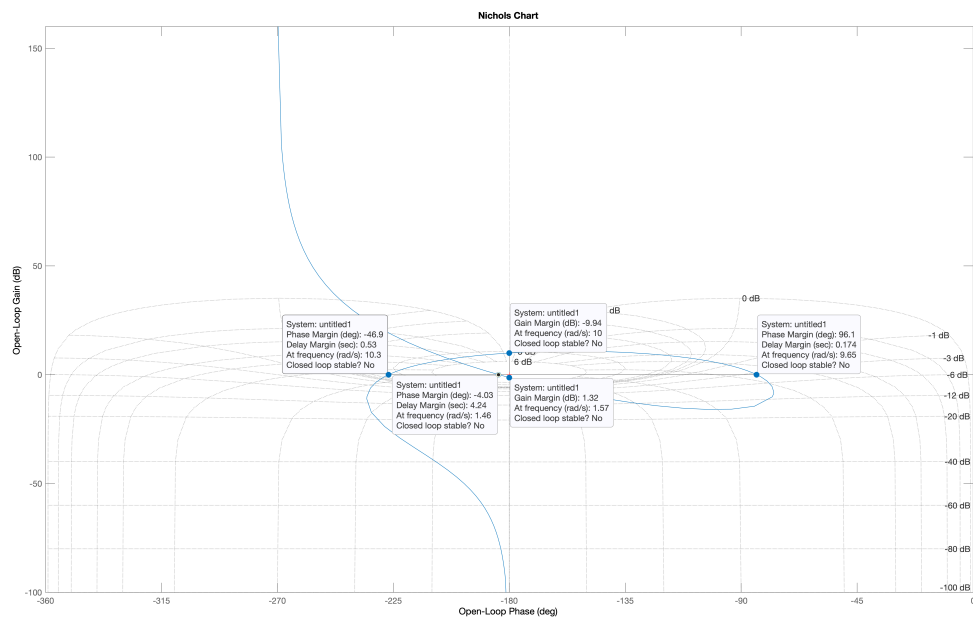Figure 1: Nichols chart for $KG, (K = 0.5)$

- $K = 1$

Figure 2: Nichols chart for $KG, (K = 1)$

- $K = 5$

Figure 3: Nichols chart for $KG, (K = 5)$

Phase margin and gain margin are shown in above figures and all closed loop systems are unstable with K form 1 to 5. In all of them phase margin is negetive.
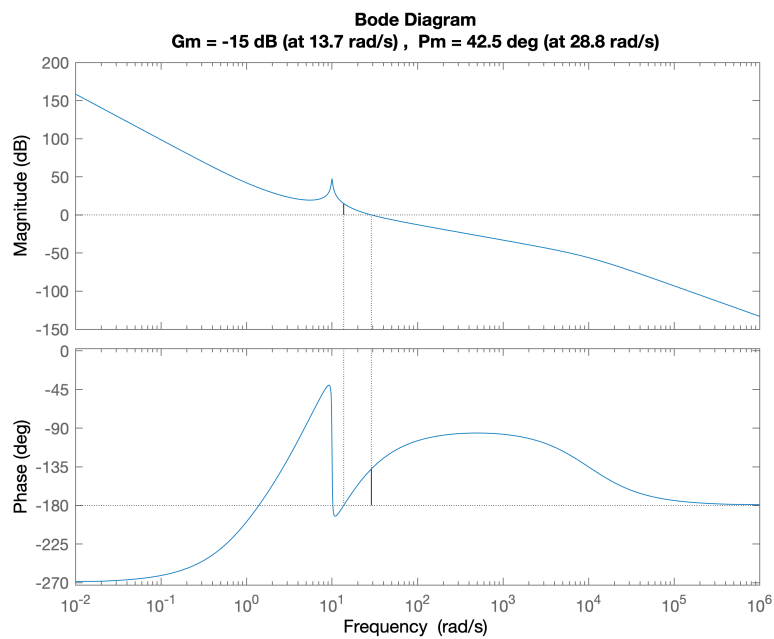
1.2   part b

I use a zero and a far pole to make controller feasible.

Controller:
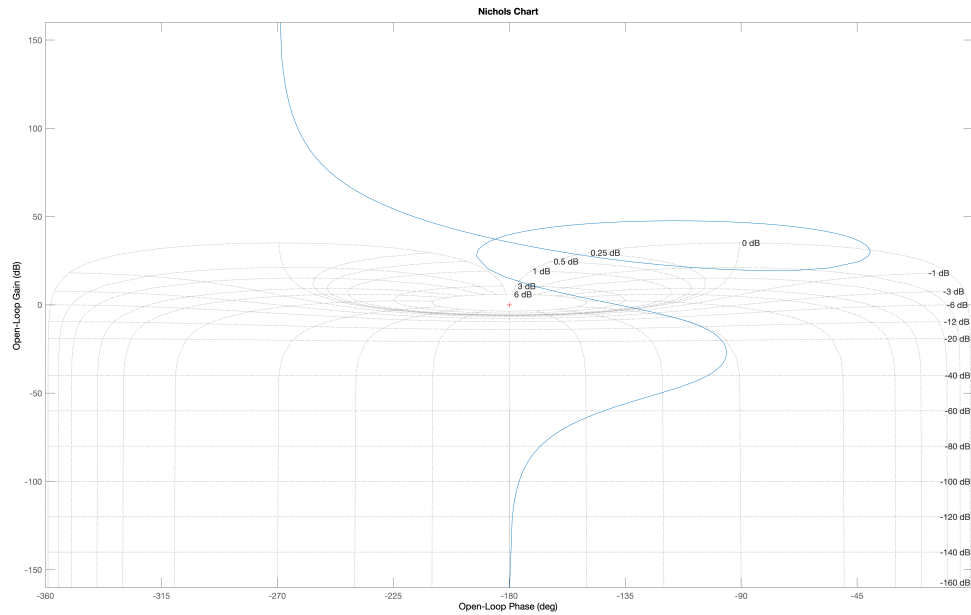$$C(s) = \frac{2.2368 \times 10^5 (s + 11.91)}{s + 10^4}$$

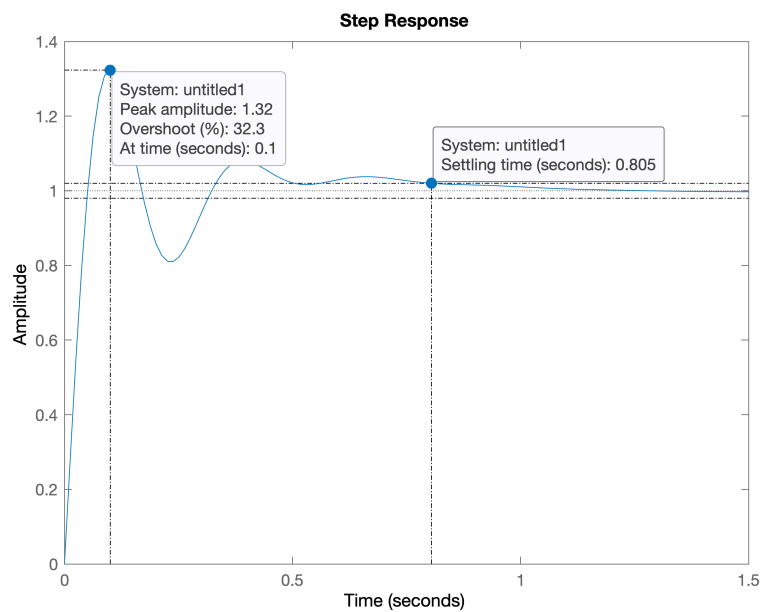Phase margin is above 40 degree.

Figure 4: Phase margin with controller

Maximum closed loop is below than 3 decibels.

Figure 5: Nichols chart with controller

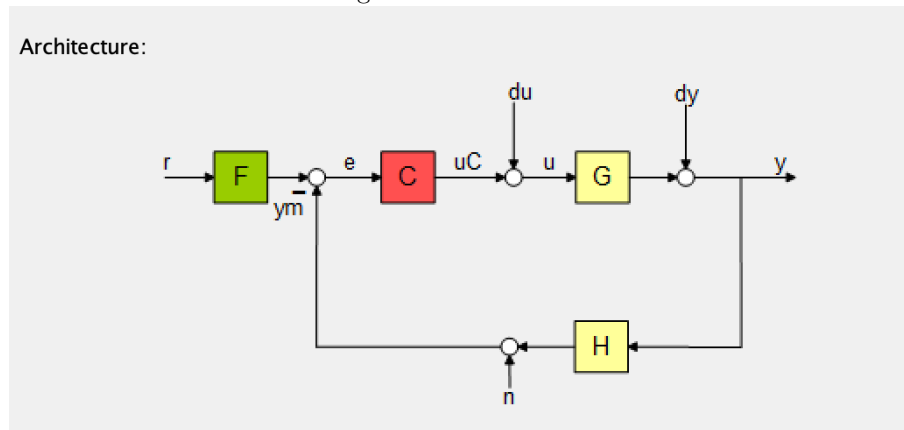Setteing time and overshoot for step responde in closed loop system are shown in figure.
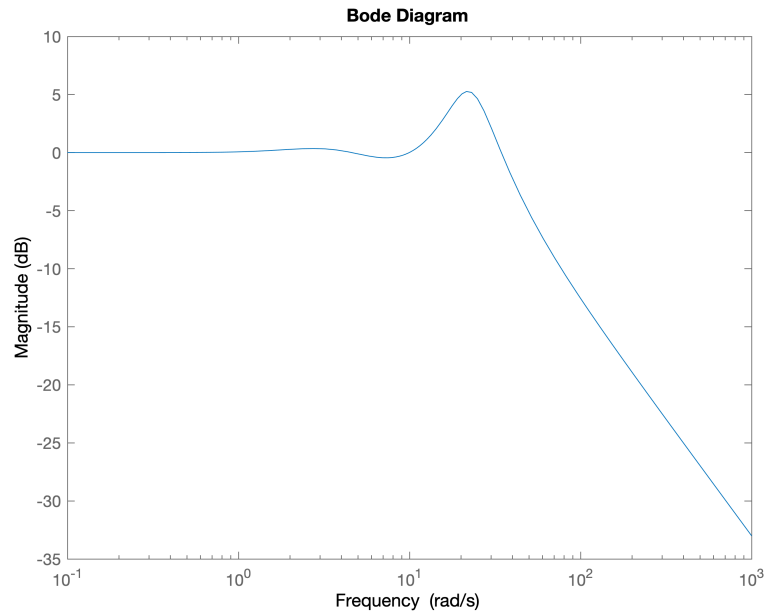
Figure 6: Step responde

1.3   part c

For transfer function we use common architecture.
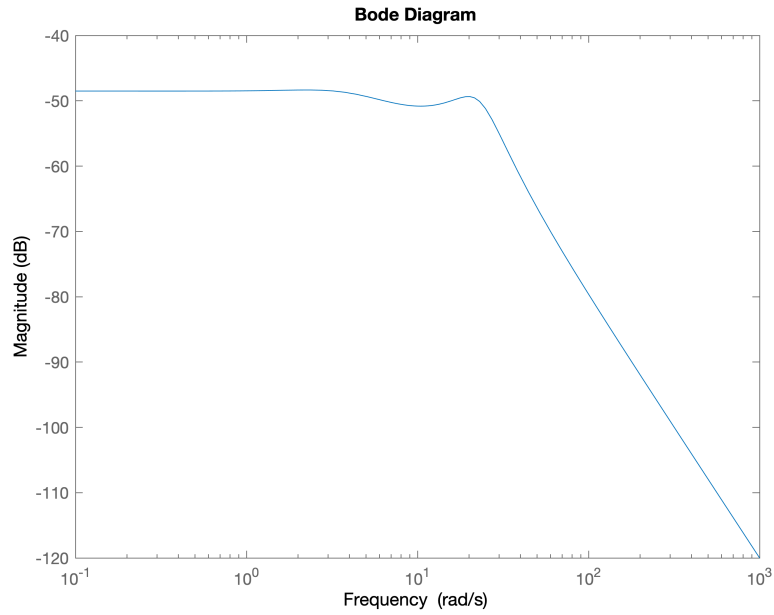
Figure 7: Architecture

- r to y refrence

Figure 8: r to y bode magnitude

System has a good performance at high frequency but not good performance at low frequency.
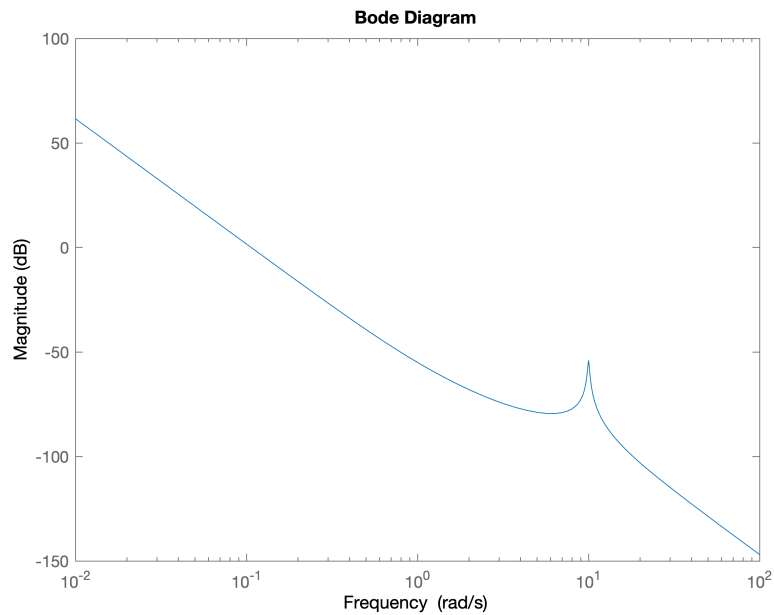
- du to y distubance

Figure 9: du to y bode magnitude

System has a better performance at high frequency but pretty good performance at low frequency.
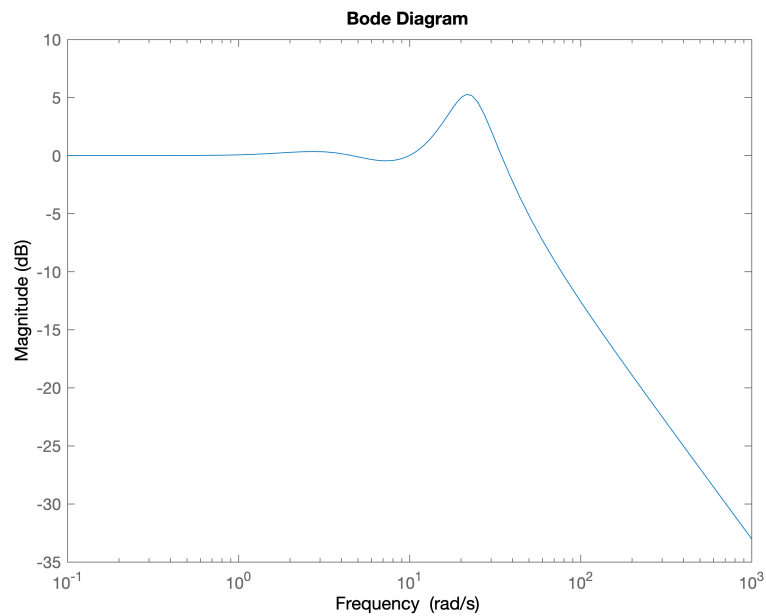
- dy to y distubance

Figure 10: dy to y bode magnitude

System has a good performance at high frequency but very bad performance at low frequency.
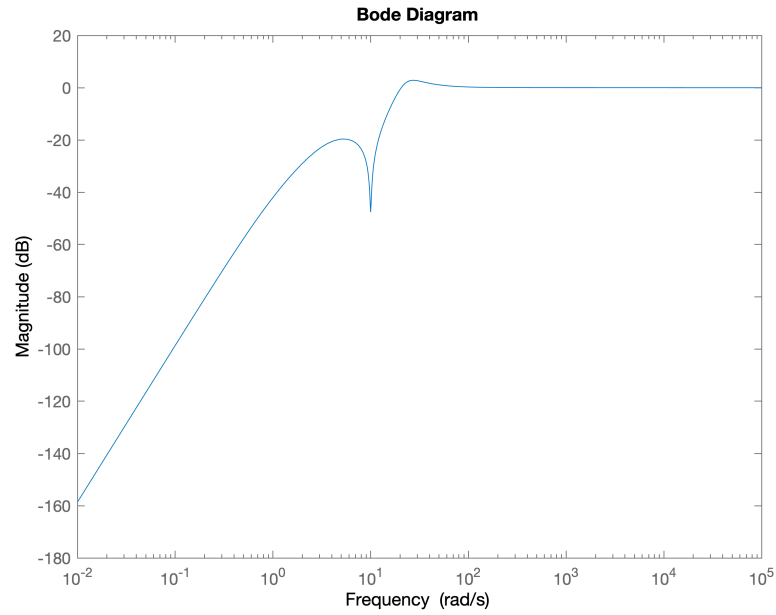
- n to y noise

Figure 11: n to y bode magnitude

System has a good performance at high frequency but not good performance at low frequency.
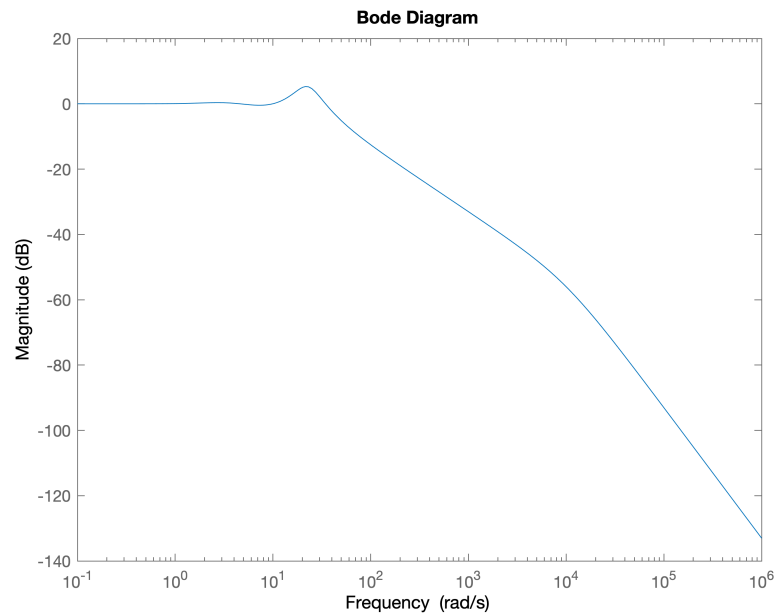
1.4   part d

- sensitivity function

Figure 12: sensitivity function bode magnitude

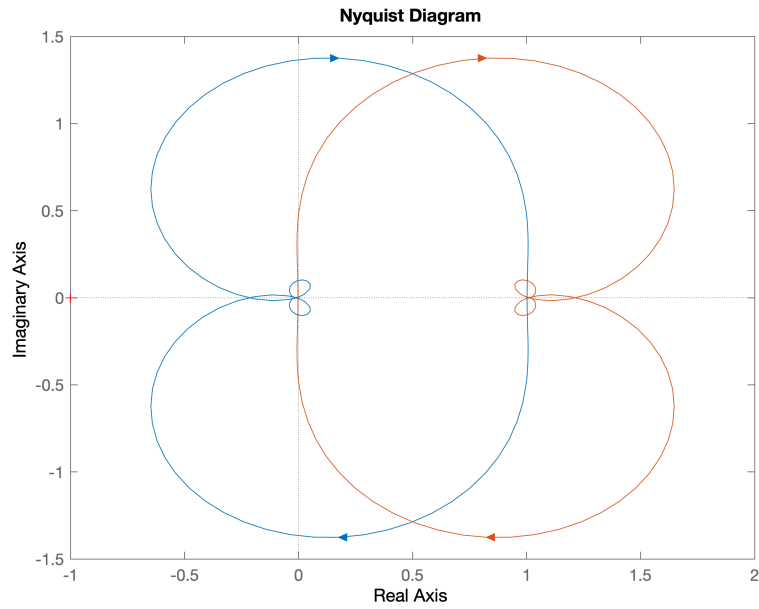System sensitivity is very hight at high frequency but low at low frequency.

- complementary sensitivity function

Figure 13: complementary sensitivity function bode magnitude

• Nichols chart for sensitivity function and complementary sensitivity function

Figure 14: nyquist chart

Contents

List of Figures

List of Tables