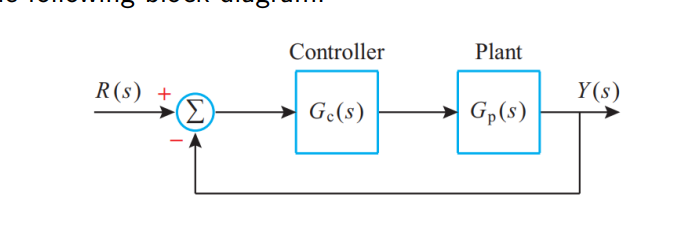
**EE49001: Control and Electronic System Design**

Assignment-3: Determination of DC Gain, Part:1

Submitted By:

21EE30004: Anirvan Krishna | 21EE30001: Aditya Kumar



From the above block diagram

# Design K such that gain crossover frequency is 2 rad/s

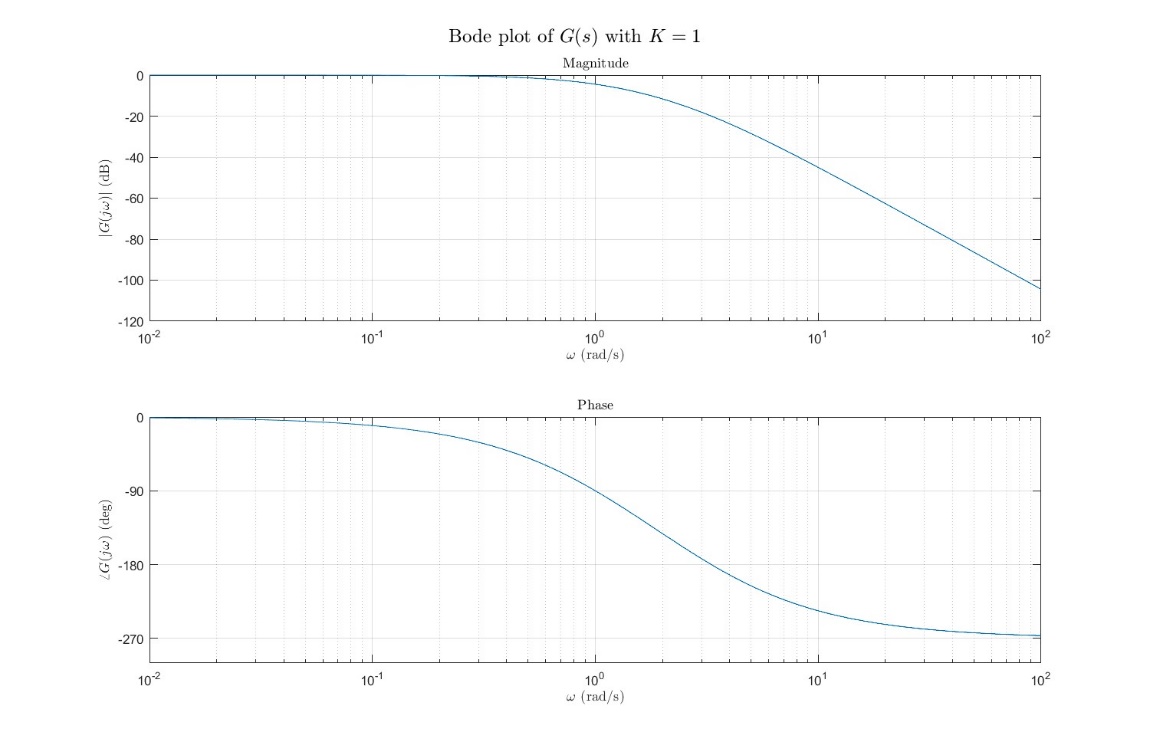
## Theoretically

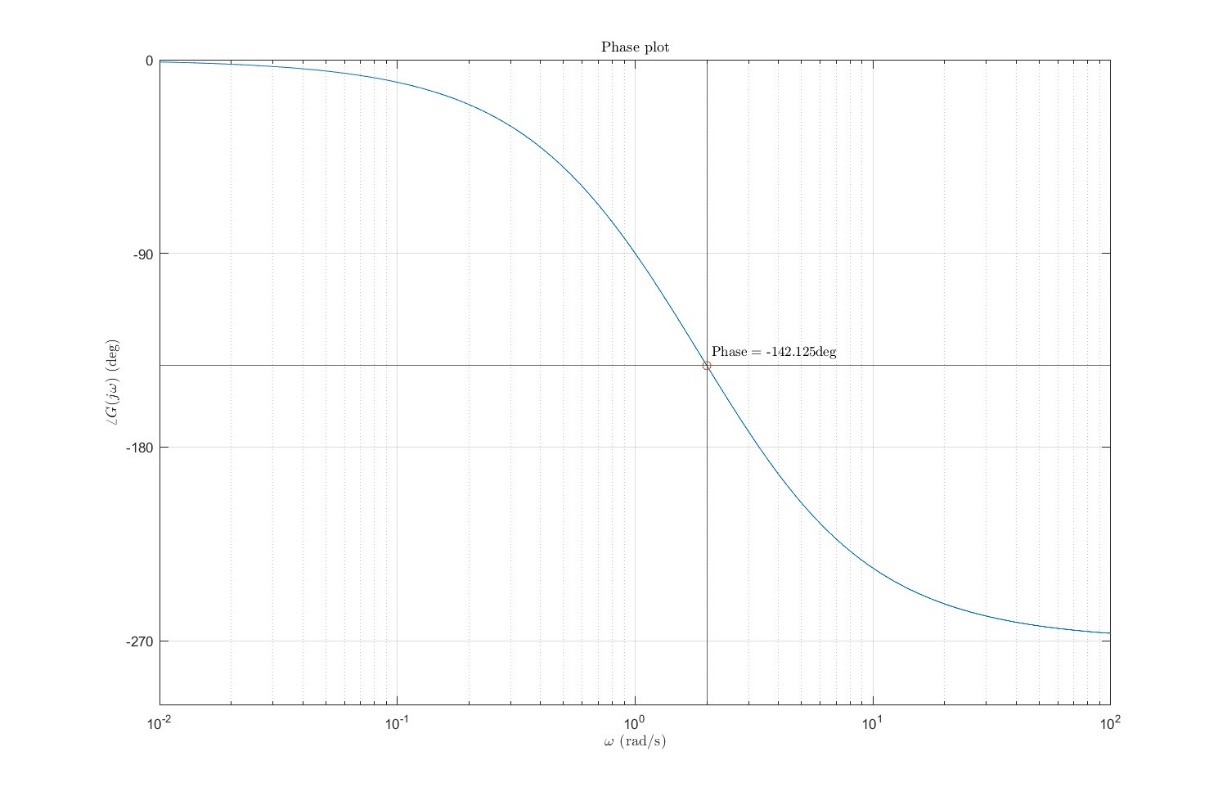
From the above-mentioned transfer function, the gain equation is

For gain crossover frequency to be to be

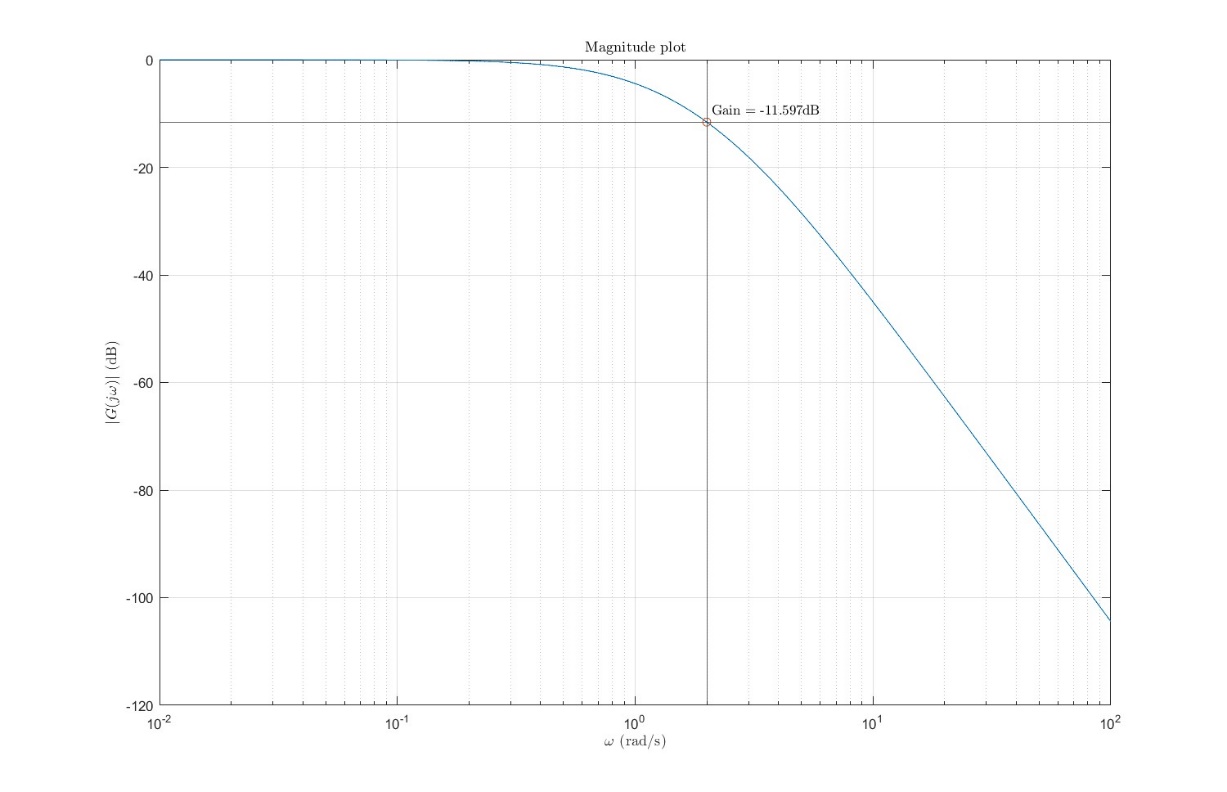
## Design Steps

If is used in the transfer function the following Bode plot is obtained





From the phase plot of it is evident that . Thus and it can be concluded that gain crossover frequency of can be achieved.



As can be observed, , thus to intersect the line at the magnitude plot must be pulled down by .

Therefore, our required DC gain is

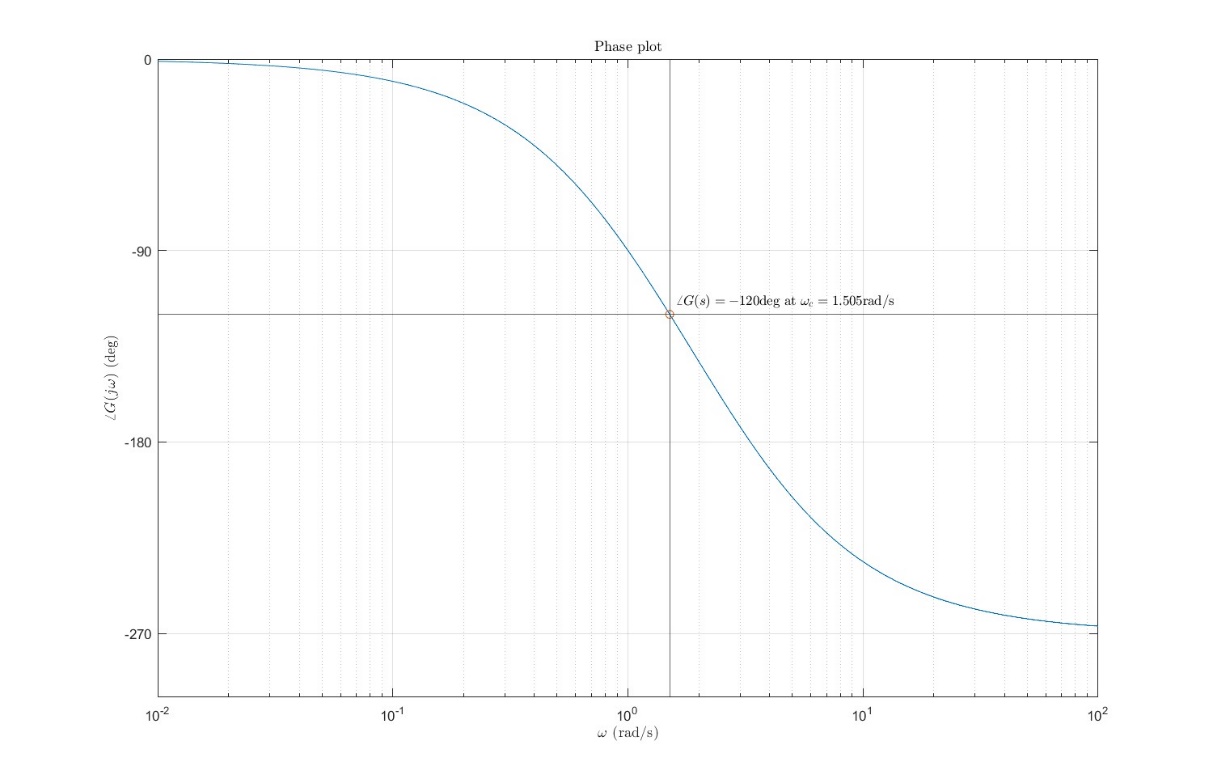
Which is very close to our calculated value in the first step.

# Design K such that Phase Margin is 60deg

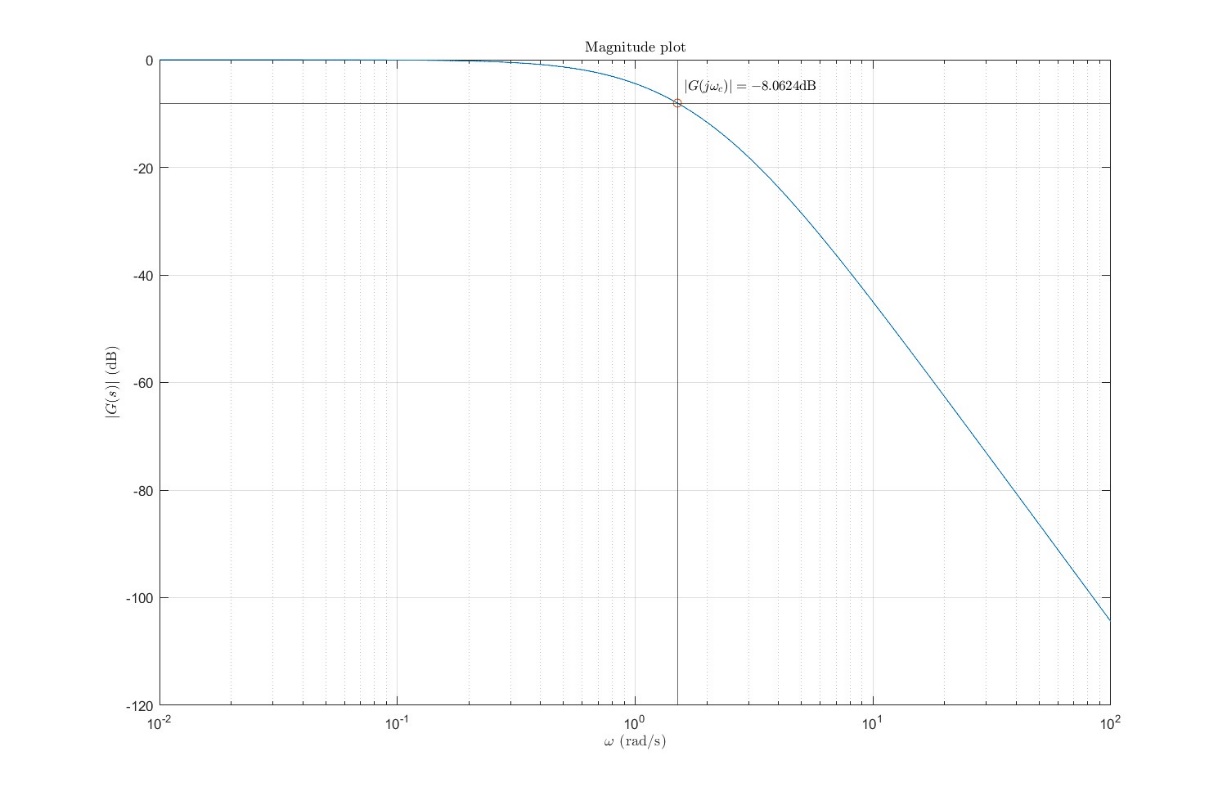
## Theoretically

Therefore,

## Design steps



From the phase plot it can be seen that for



As can be observed from the magnitude plot that the magnitude plot needs to be pulled down by so that it intersects line at .

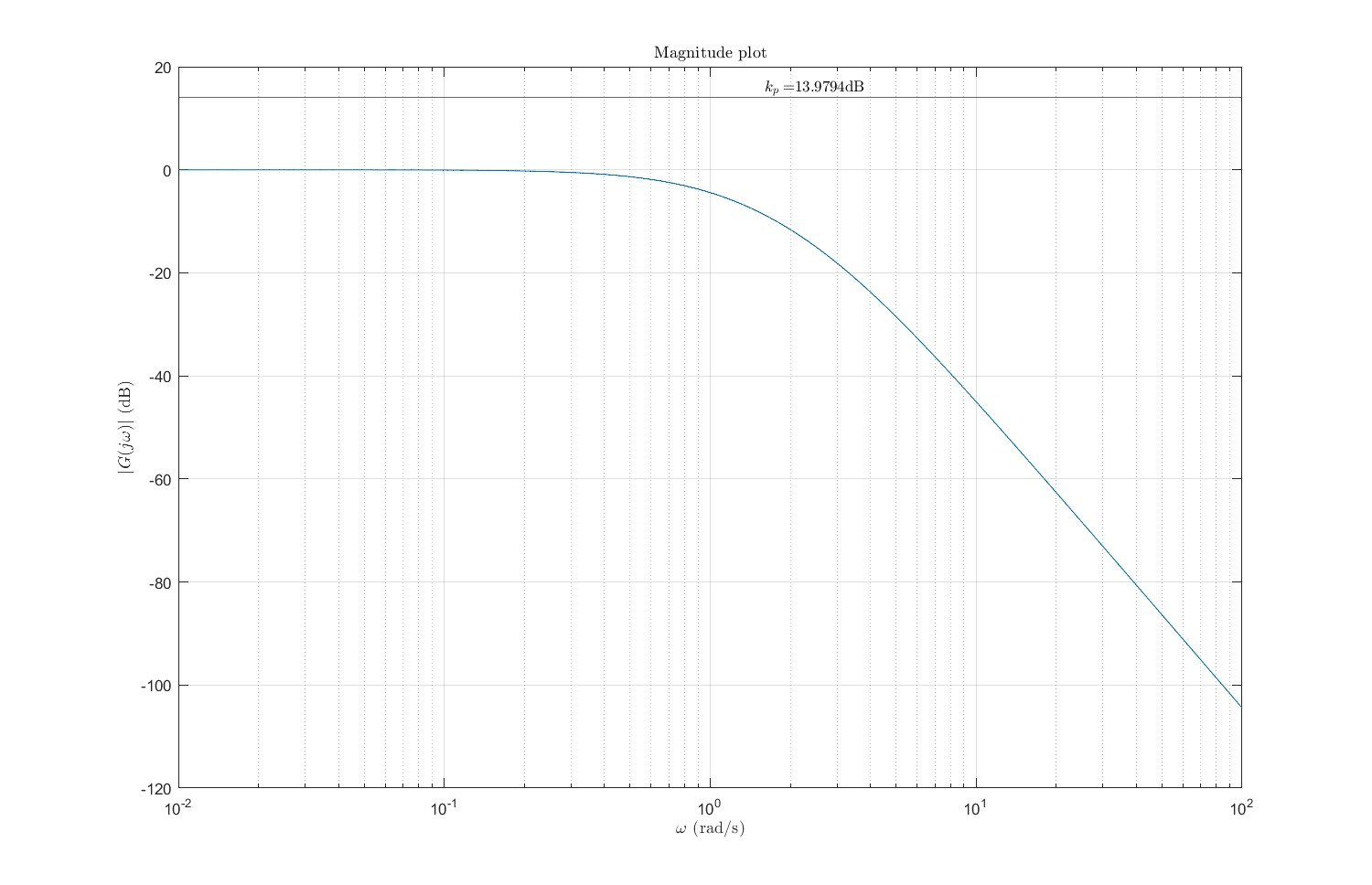
Therefore, our required DC gain is

# Design K such that Position Error Constant is 5

## Theoretically

For a unity feedback system, as is given, the position error constant can be defined as

## Design Steps



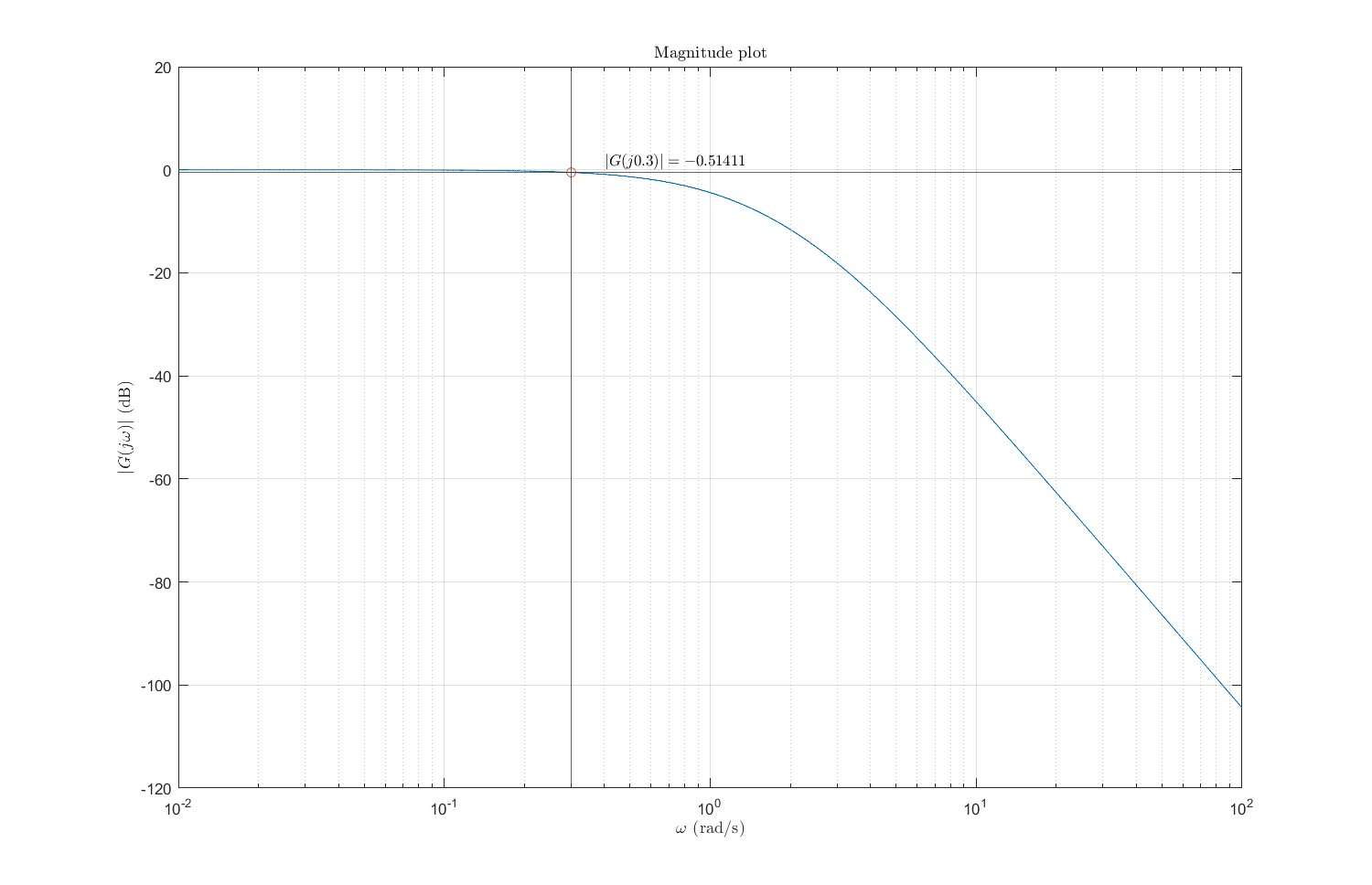
Therefore, from the above magnitude plot the it can be observed that at the low frequency end, where the plot is flat, it is lower than the desired by 13.9794dB (since the magnitude plot is flat at 0dB). Thus, the plot needs to be shifted up by 13.9794dB. Hence our required DC gain will be

# Design K such that

## Theoretically

Since it is sufficient to make for the said condition to hold. Therefore,

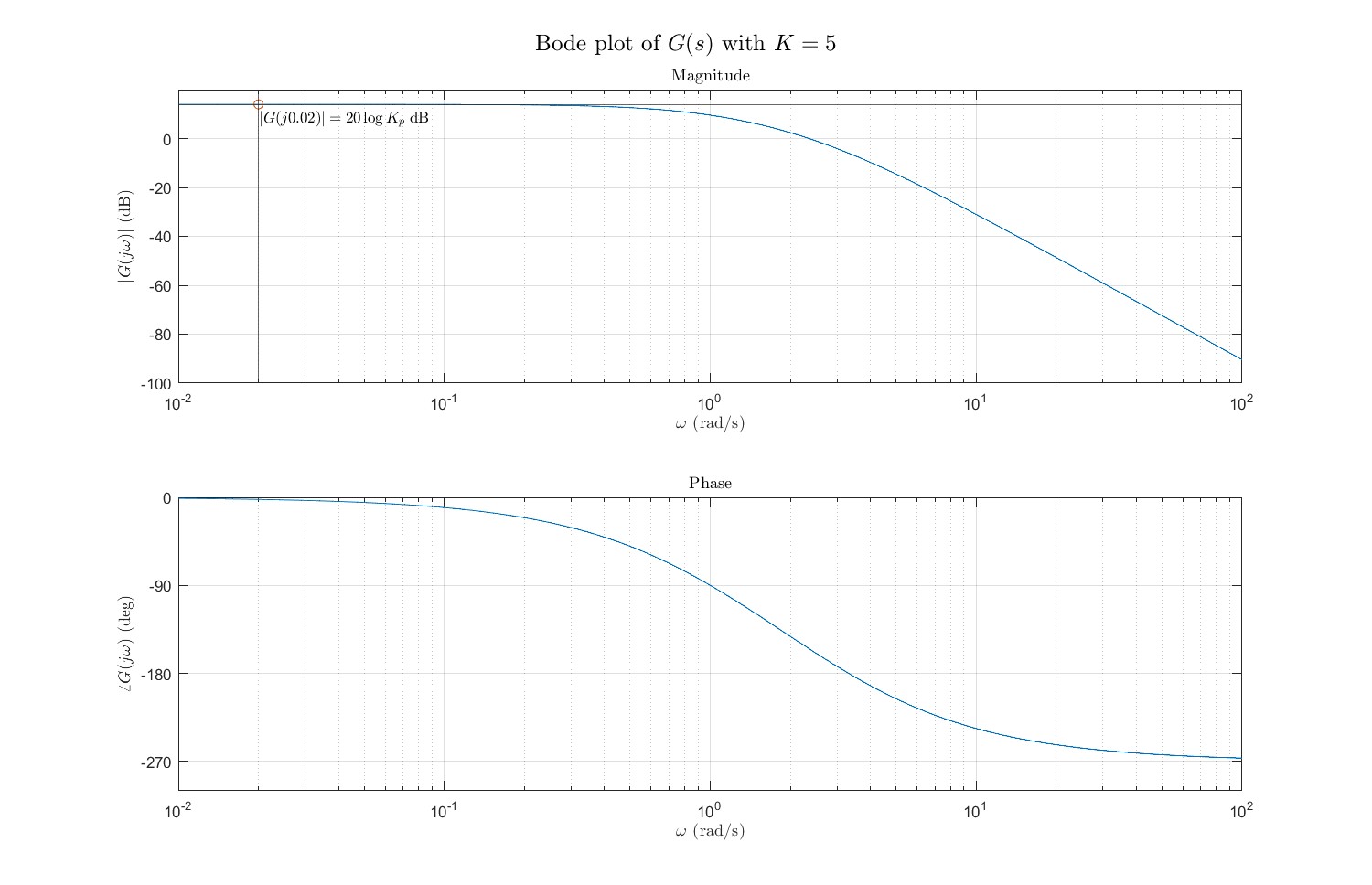
## Design Steps



Since , thus to bring , we need to shift the magnitude plot up by . Therefore, our required DC gain is

# Desired Plots

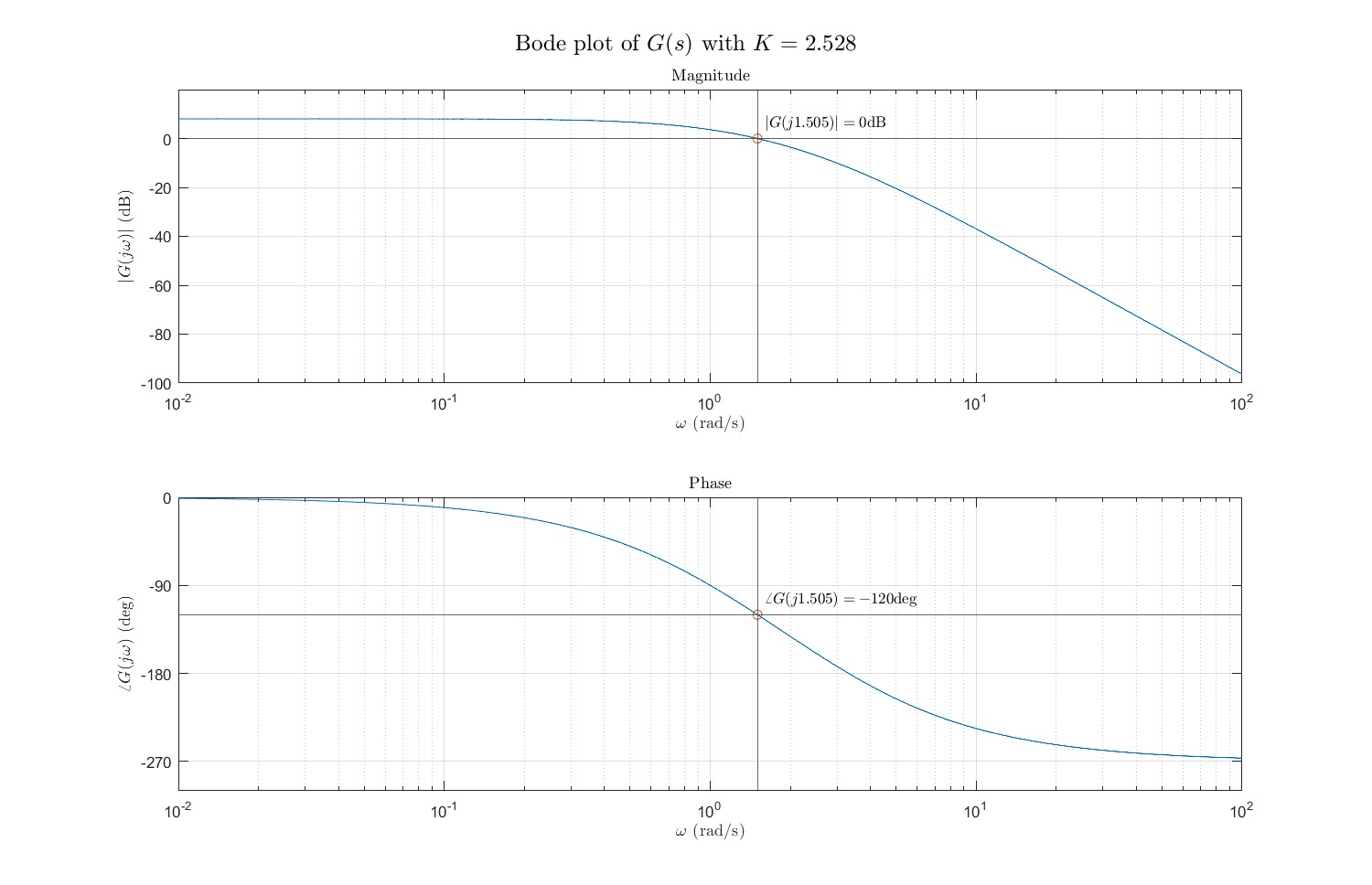
## Position Error Constant is 5

K is set to 5 as obtained before in our calculation and the bode plot of is obtained.

As can be observed the gain at lower frequencies (assumed 0.02) is around 13.979 with is approximately equal to . Thus, it can be concluded that the position error constant is 5.

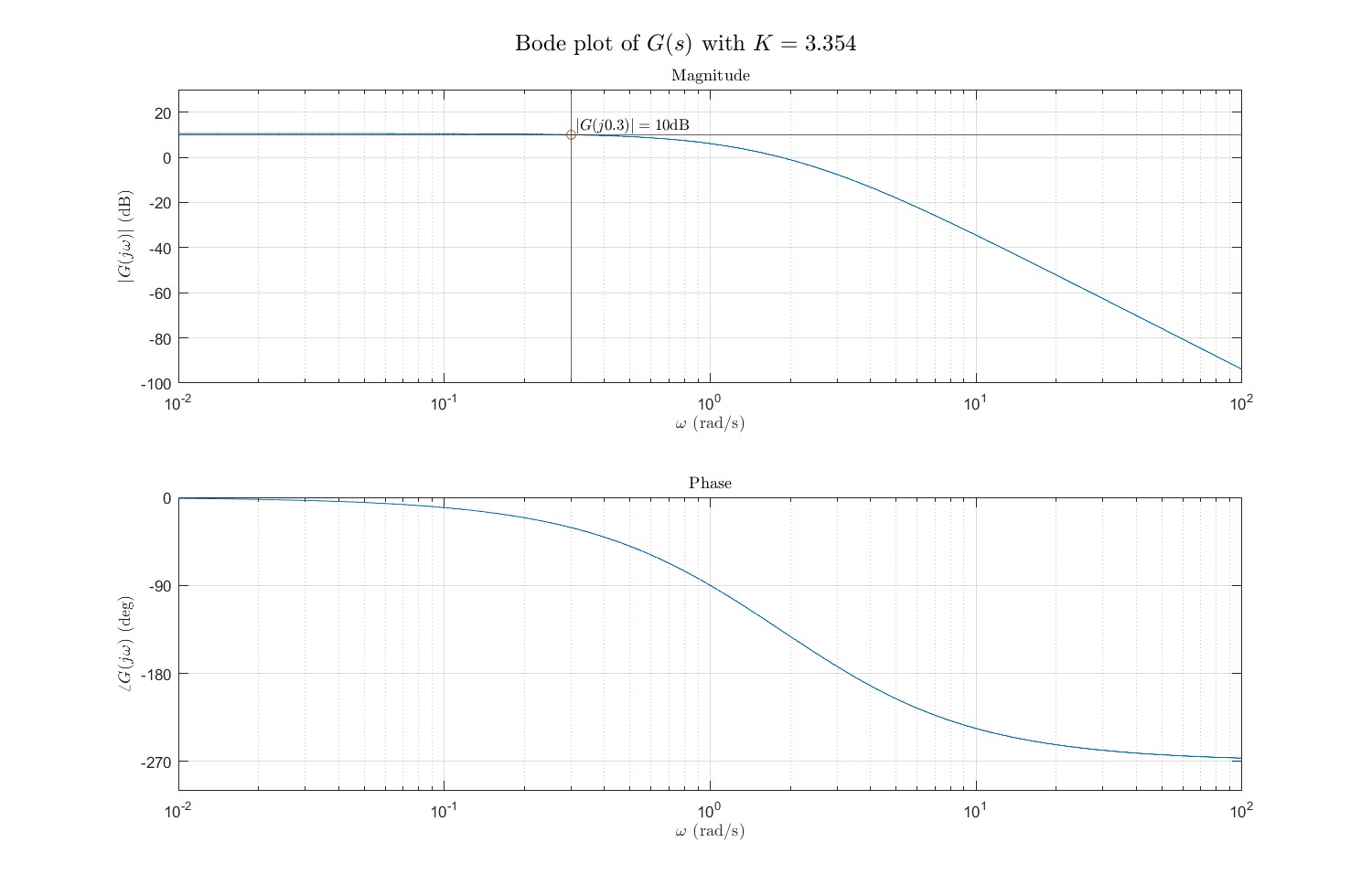
## Phase Margin is 60deg

K is set to 2.528 as obtained before in our calculation and the bode plot of is obtained.



As can be observed from the above bode plot, the gain crossover frequency is 1.505 rad/s and correspondingly . Thus, the phase margin will be Therefore, design of K is just as expected.

## Gain at 0.3 is greater than 10dB

K is set to 3.354 as obtained before our calculation and the bode plot of is obtained.

As can be observed that the gain at 0.3 rad/s is 10 dB which is consistent to our design goals.