Contents

Homework 3

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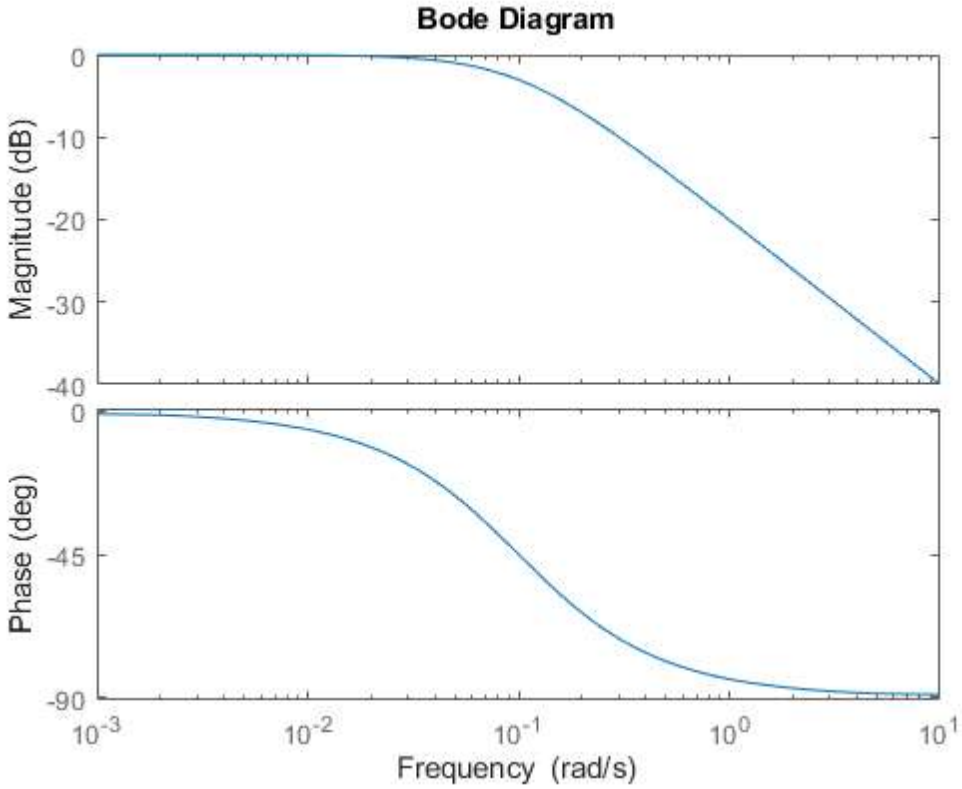
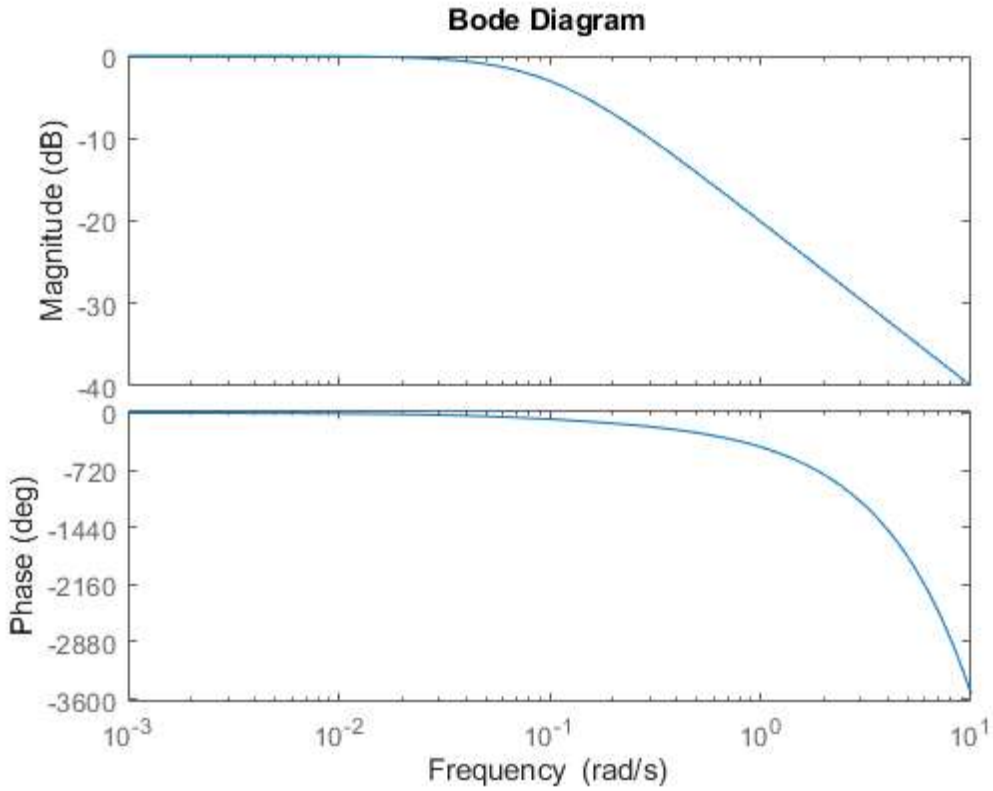
```
clc;
clear;
clf;
close all;
```

Problem 1

```
G_delay = tf([0.1], [1 0.1], 'InputDelay', 6); % G plant with delay
G = tf([0.1], [1 0.1]); % G plant without delay

% without delay
figure(1)
bodeplot(G);

% with delay
figure(2)
bodeplot(G_delay);
```

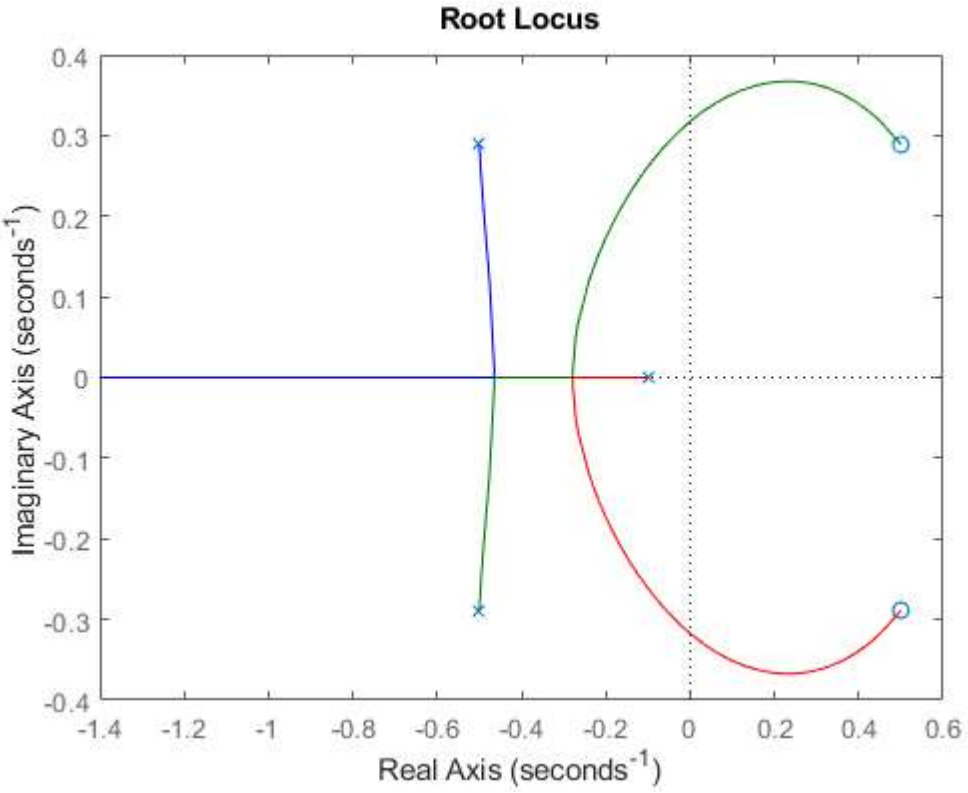


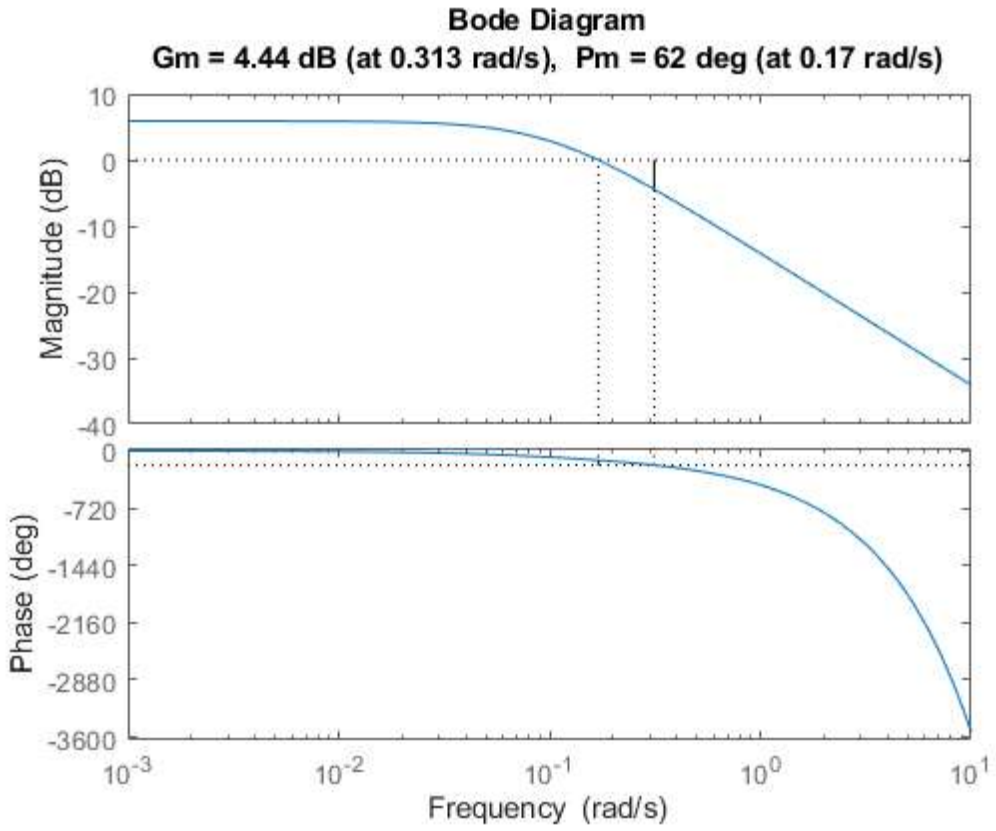


Problem 2

```
D_prop = tf([0.6], [1]); % exclude ku
G_pade = pade(G_delay,2); % pade approx. for time delay
```

```
% Find K = Ku
figure(3)
rlocus(G_pade);

[Gm_init, Pm_init, Wcg_init, Wcp_init] = margin(G_delay);

Ku = Gm_init;

% Apply Kp = alpha*Ku as D(s)
alpha = 0.6;
L_prop = alpha * Ku * G_delay;

figure(4)
margin(L_prop);

[Gm_fin, Pm_fin, Wcg_fin, Wcp_fin] = margin(L_prop);
```



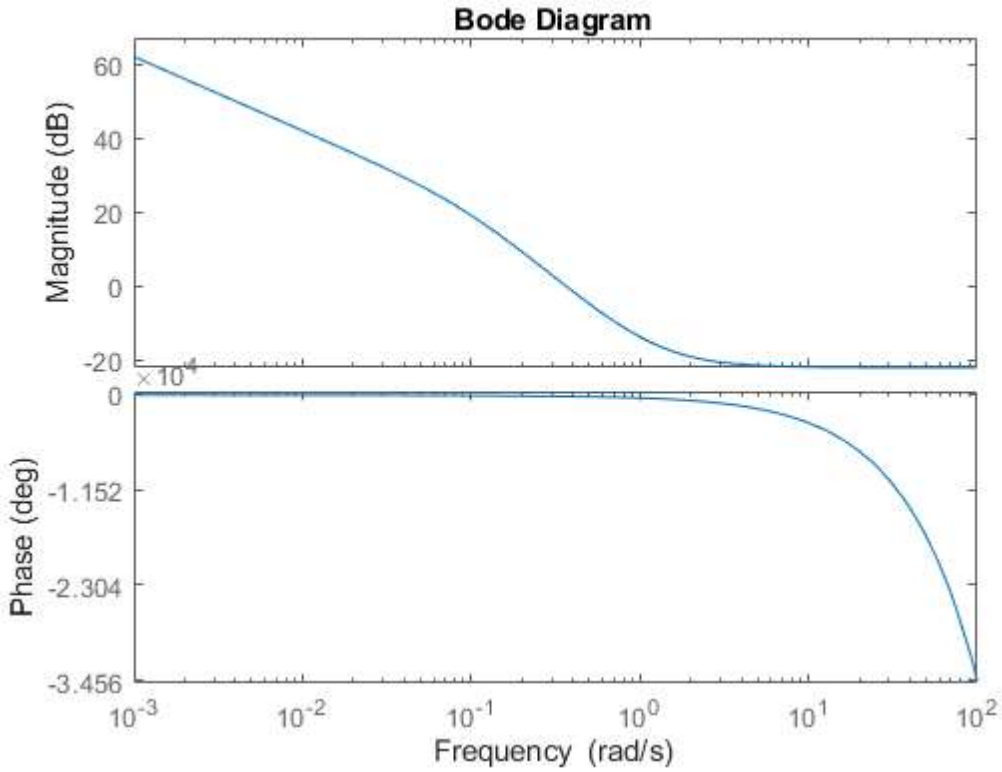


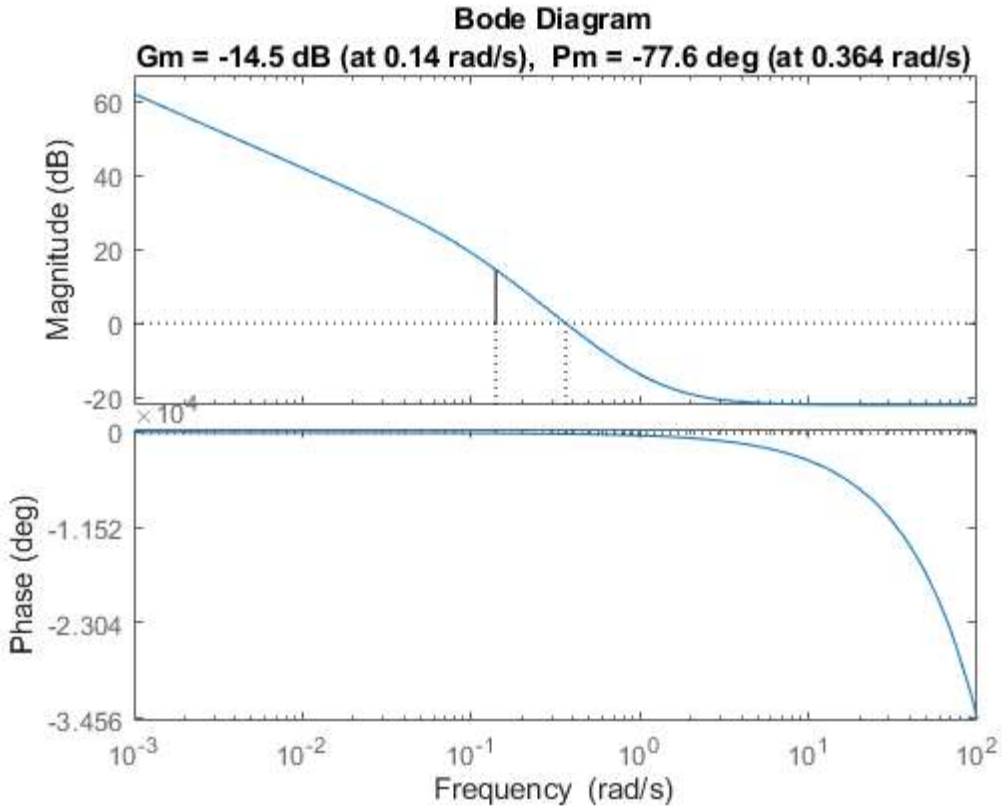
Problem 4a

```
D_pid = 0.78697*tf([1 2.54 1.61], [1 0]);
L_pid = G_delay * D_pid;
```

```
figure(5)
bodeplot(L_pid);

figure(6)
margin(L_pid);

[Gm_fin2, Pm_fin2, Wcg_fin2, Wcp_fin2] = margin(L_pid);
```

```
Warning: The closed-loop system is unstable.
```





Problem 6a

```
G_c2d= c2d(G * tf([1],[1 0]), 2, 'zoh');
G_disc1 = tf([1 -1],[1 0 0 0 0],2);
G_disc_fin = G_c2d * G_disc1;
```

```
% simplified G(z)
G_disc_fin2 = tf([0.1873 0.1752],[1 -0.8187 0 0 0 0], 2);
```

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