Contents

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

Problem 2

```
Ts = 0.6;
K = 1;
K = 1.68;
%K = 10;
Gs = tf(2, [1 0.5])

Gz = c2d(Gs, Ts)
Gzcl = feedback(K*Gz, 0.04)

figure(1);
hold on;
grid on;
bode(Gzcl);
hold off;
```

```
Gs =

      2
  -------
  s + 0.5

Continuous-time transfer function.


Gz =

    1.037
  ----------
  z - 0.7408

Sample time: 0.6 seconds
Discrete-time transfer function.


Gzcl =

    1.742
  ----------
  z - 0.6712

Sample time: 0.6 seconds
Discrete-time transfer function.
```
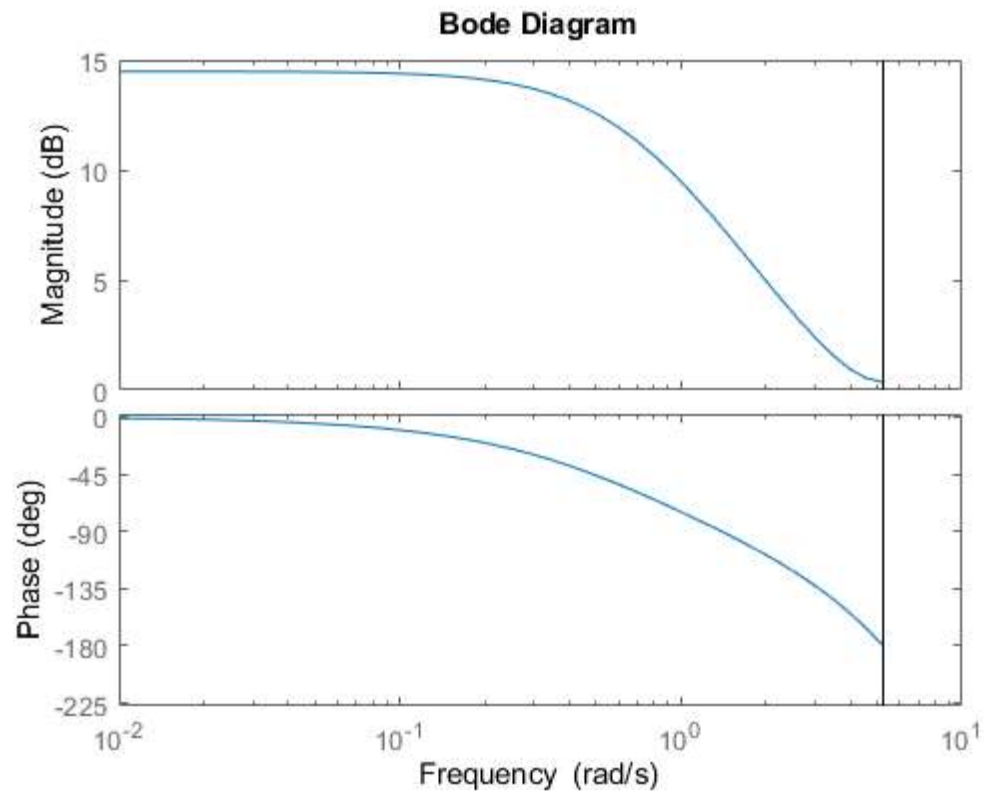
Bode Diagram

Problem 4

```matlab
figure(3);
Ts = 0.001;
delta = 1/sqrt(2);
wo = 2*pi*60;

Gs = tf([1 0 wo^2],[1 2*delta*wo wo^2])

Gz1 = c2d(Gs, Ts, 'tustin')

opt = c2dOptions('method', 'tustin', 'PrewarpFrequency', 377)
Gz2 = c2d(Gs, Ts, opt);

Gz3 = c2d(Gs, Ts, 'matched')


Gzdiff = tf([0.682 -1.194 0.597], [1 -1.512 0.597]);
t = 0:Ts:0.1;
% plots for problem 4
sig = sin(2*pi*60*t)+sin(2*pi*10*t);

% plot a
subplot(2,2,1);
title('Backwards Difference Approximation');
xlabel('Time (s)');
ylabel('Response');
grid on;
hold on;
plot(t, sig);
[n,d] = tfdata(Gzdiff);
n = cell2mat(n);
d = cell2mat(d);
```

```matlab
plot(t, filter(n,d, sig));
hold off;

% plot b
subplot(2,2,2);
title('Bilinear Transform');
xlabel('Time (s)');
ylabel('Response');
grid on;
hold on;
plot(t, sig);
[n,d] = tfdata(Gz1);
n = cell2mat(n);
d = cell2mat(d);
plot(t, filter(n,d, sig));
hold off;

% plot c
subplot(2,2,3);
title('Bilinear Transform with pre-warping');
xlabel('Time (s)');
ylabel('Response');
grid on;
hold on;
plot(t, sig);
[n,d] = tfdata(Gz2);
n = cell2mat(n);
d = cell2mat(d);
plot(t, filter(n,d, sig));
hold off;

% plot b
subplot(2,2,4);
title('Matched Pole-Zero Method');
xlabel('Time (s)');
ylabel('Response');
grid on;
hold on;
plot(t, sig);
[n,d] = tfdata(Gz3);
n = cell2mat(n);
d = cell2mat(d);
plot(t, filter(n,d, sig));
hold off;
```

```
Gs =

        s^2 + 1.421e05
  -------------------------
  s^2 + 533.1 s + 1.421e05

Continuous-time transfer function.


Gz1 =

  0.7953 z^2 - 1.481 z + 0.7953
  -----------------------------
      z^2 - 1.481 z + 0.5906
```

```
Sample time: 0.001 seconds
Discrete-time transfer function.


Gz3 =

  0.7751 z^2 - 1.441 z + 0.7751
  -----------------------------
     z^2 - 1.478 z + 0.5868


Sample time: 0.001 seconds
Discrete-time transfer function.
```