HW 3

```
clear; clc; clf;
% Q1-Q3
ao = 0.1
```

```
ao = 0.1000
```

```
bo = ao
```

```
bo = 0.1000
```

```
d = 6;
num = [bo];
den = [1 ao];
eh = tf(num,den,'InputDelay',d)
```

```
eh =

                0.1
  exp(-6*s) * -------
              s + 0.1

Continuous-time transfer function.
Model Properties
```

```
beh = tf(num,den)
```

```
beh =

    0.1
  -------
  s + 0.1

Continuous-time transfer function.
Model Properties
```

```
[NUM DEN] = pade(6,2)
```

```
NUM = 1×3
    1.0000   -1.0000    0.3333
DEN = 1×3
    1.0000    1.0000    0.3333
```

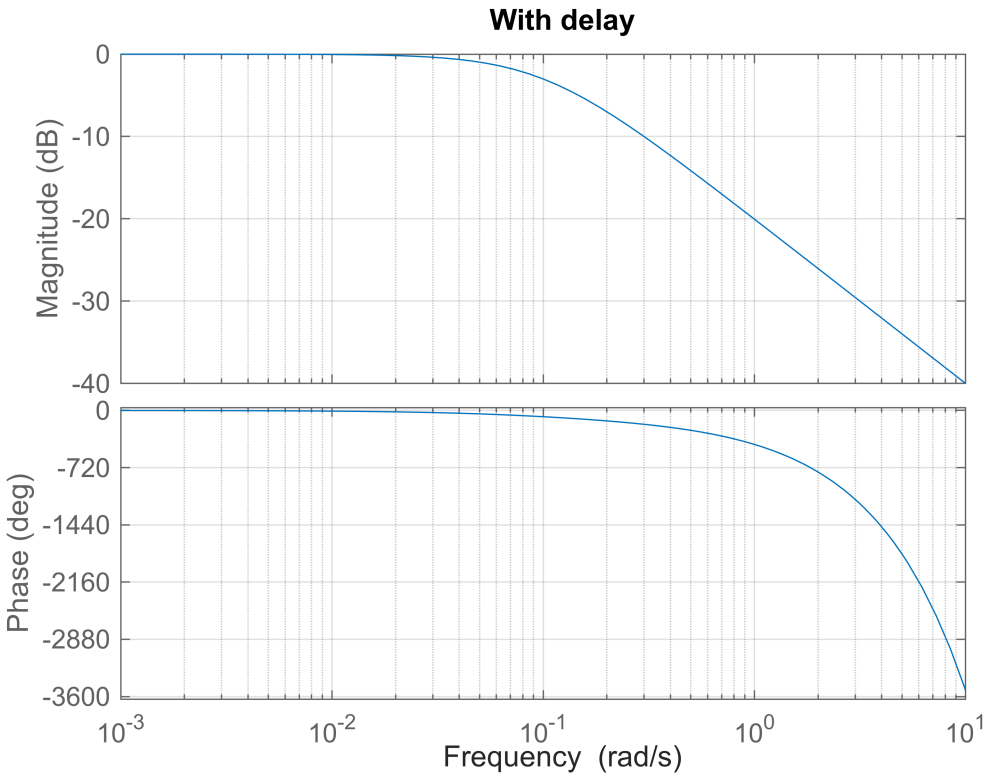
```
sure = tf(NUM,DEN)
```

```
sure =

  s^2 - s + 0.3333
  ----------------
  s^2 + s + 0.3333

Continuous-time transfer function.
Model Properties
```

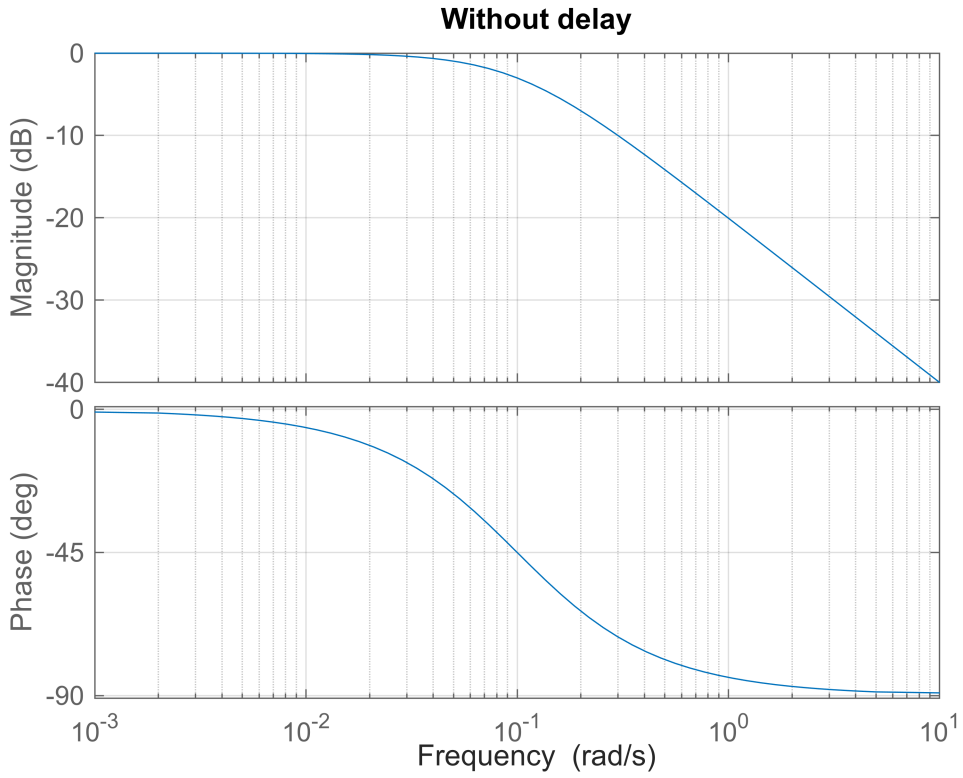
```
ehbeh = sure*beh
```

```
ehbeh =

      0.1 s^2 - 0.1 s + 0.03333
  ---------------------------------
  s^3 + 1.1 s^2 + 0.4333 s + 0.03333

Continuous-time transfer function.
Model Properties
```

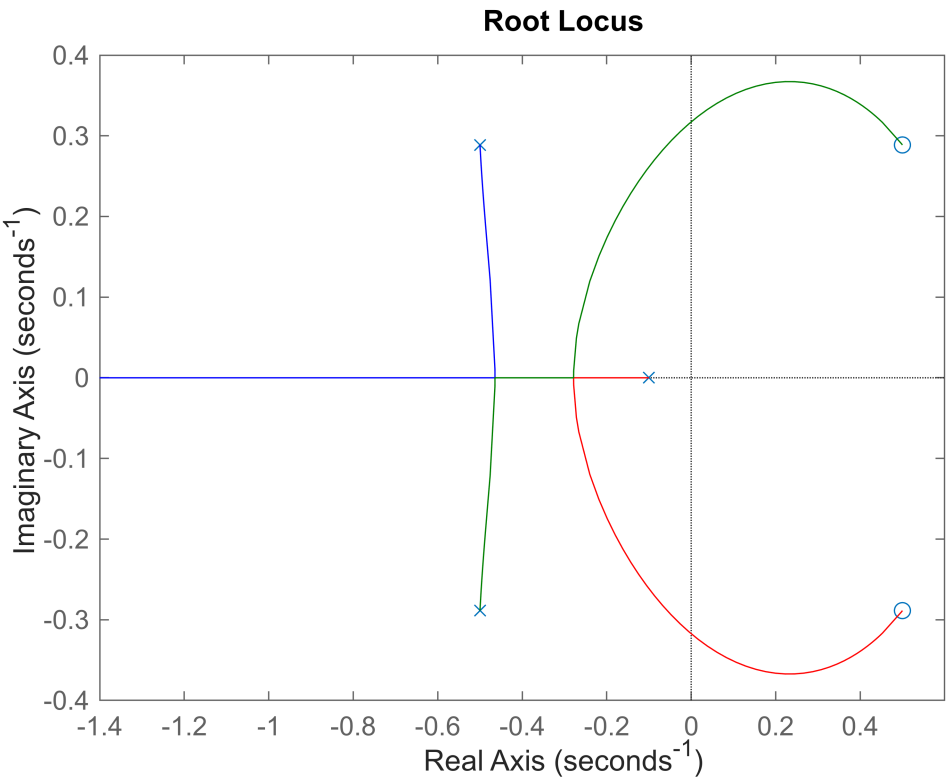
```
figure(1);
hold on;
bode(eh)
grid on;
title('With delay')
hold off;
```




```
figure(2);
hold on;
bode(beh)
grid on;
title('Without delay')
hold off;
```




```
figure(3);
rlocus(ehbeh)
```




```
%grid on;
```

Q4

```
clear; clc;

ao = 0.1
```

```
ao = 0.1000
```

```
bo = ao
```

```
bo = 0.1000
```

```
d = 6;
Ku = 3.26;
wu = 0.316;
Tu = 1/0.3;
a = 0.6;
b = 0.5;
c = 0.125;

% Q4a

Kp = a*Ku
```

```
Kp = 1.9560
```

```
Ti = b*Tu
```

```
Ti = 1.6667
```

```
Td = c*Tu
```

```
Td = 0.4167
```

```
num = [bo];
den = [1 ao];
beh = tf(num,den)
```

```
beh =

    0.1
  -------
  s + 0.1

Continuous-time transfer function.
Model Properties
```

```
[NUM DEN] = pade(6,2)
```

```
NUM = 1×3
    1.0000   -1.0000    0.3333
DEN = 1×3
    1.0000    1.0000    0.3333
```

```
sure = tf(NUM,DEN)
```

```
sure =

  s^2 - s + 0.3333
  ----------------
  s^2 + s + 0.3333

Continuous-time transfer function.
Model Properties
```

```
ehbeh = sure*beh
```

```
ehbeh =

      0.1 s^2 - 0.1 s + 0.03333
  ---------------------------------
  s^3 + 1.1 s^2 + 0.4333 s + 0.03333

Continuous-time transfer function.
Model Properties
```

```
num = [Kp*Td Kp Kp/Ti]
```

```
num = 1×3
    0.8150    1.9560    1.1736
```

```
den = [1 0]
```

```
den = 1×2
     1     0
```

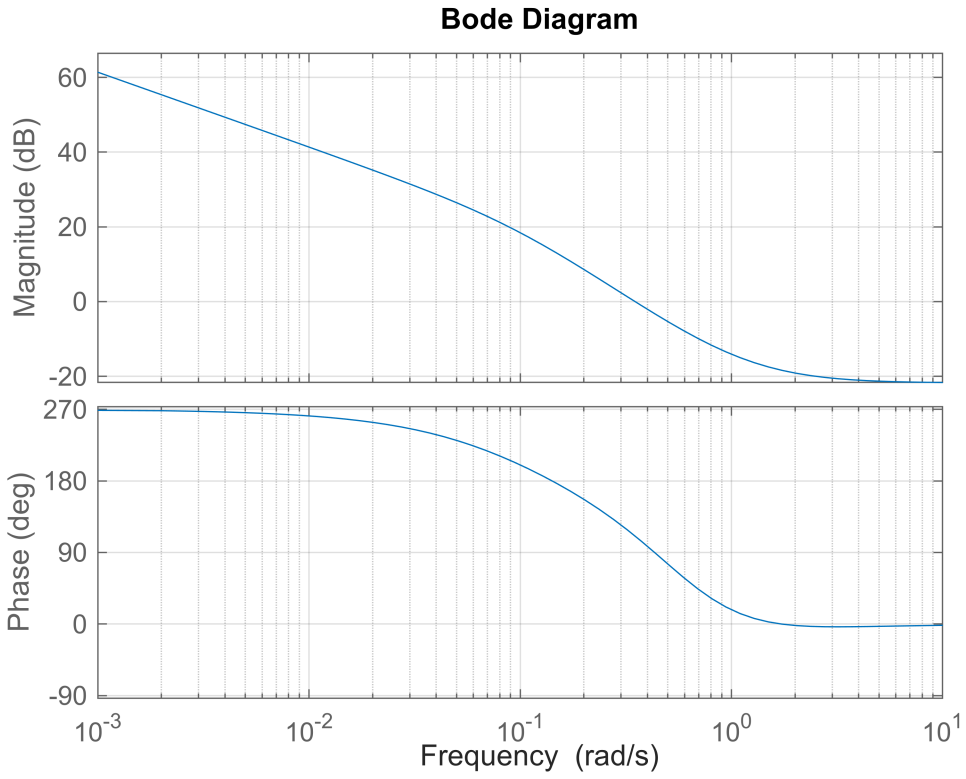
```
Ds = tf(num,den)
```

```
Ds =

  0.815 s^2 + 1.956 s + 1.174
  ---------------------------
               s

Continuous-time transfer function.
Model Properties
```

```
ew = Ds*ehbeh
```

```
ew =

  0.0815 s^4 + 0.1141 s^3 - 0.05107 s^2 - 0.05216 s + 0.03912
  -----------------------------------------------------------
            s^4 + 1.1 s^3 + 0.4333 s^2 + 0.03333 s

Continuous-time transfer function.
Model Properties
```

```
figure(4);
bode(ew)
grid on;
```



```
% Q4b

num = [0.0815 0.1141 -0.05108 -0.05216 0.03912]
```

```
num = 1×5
    0.0815    0.1141   -0.0511   -0.0522    0.0391
```

```
den = [1 1.1 0.4333 0.0333 0]
```

```
den = 1×5
    1.0000    1.1000    0.4333    0.0333         0
```

```
recon = tf(num,den)
```

```
recon =

  0.0815 s^4 + 0.1141 s^3 - 0.05108 s^2 - 0.05216 s + 0.03912
  -----------------------------------------------------------
             s^4 + 1.1 s^3 + 0.4333 s^2 + 0.0333 s

Continuous-time transfer function.
Model Properties
```

```
figure(5)
stepplot(recon)
grid on
```