Contents

ES155 HW6 Problem 2

```
m = 1000;
c = 50;
b = 25;
a = 0.2;
T = 200;
```

Part b

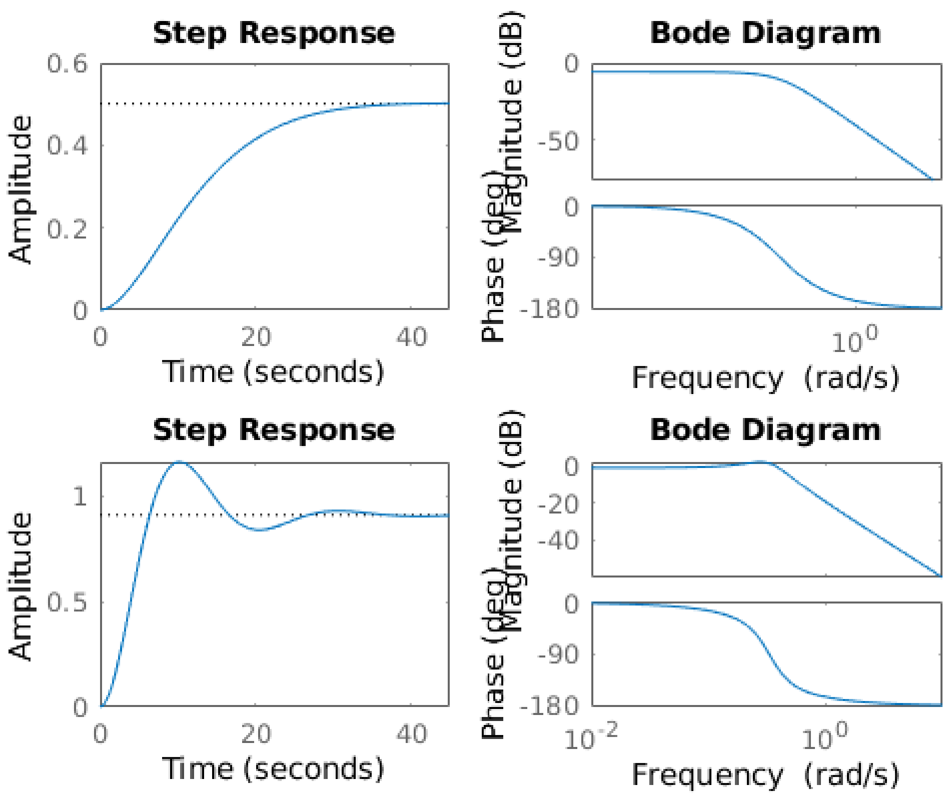
```
kp = [0.01 0.1]

figure(1); clf;
for i = 1:length(kp)

    H_eu = tf(kp(i))
    H_uT = tf(a*T, [1, a])
    H_Tv = tf(b, [m, c])
    H_ev = H_Tv * H_uT * H_eu
    H_fdbk = tf(1)
    H = feedback(H_ev, H_fdbk)

    sys = ss(H)
    subplot(length(kp),2,2*i-1)
    step(sys)

    subplot(length(kp),2, 2*i)
    bode(sys)

end
```

```
kp =

    0.0100    0.1000


H_eu =

  0.01

Static gain.


H_uT =

    40
  -------
  s + 0.2
```

```
Continuous-time transfer function.


H_Tv =

      25
  -----------
  1000 s + 50

Continuous-time transfer function.


H_ev =

           10
  ---------------------
  1000 s^2 + 250 s + 10

Continuous-time transfer function.


H_fdbk =

  1

Static gain.


H =

           10
  ---------------------
  1000 s^2 + 250 s + 20

Continuous-time transfer function.


sys =

  A =
            x1      x2
   x1    -0.25   -0.16
   x2    0.125       0

  B =
           u1
   x1    0.25
   x2       0

  C =
           x1    x2
   y1       0  0.32

  D =
       u1
   y1   0

Continuous-time state-space model.
```

```
H_eu =

  0.1

Static gain.


H_uT =

    40
  -------
  s + 0.2

Continuous-time transfer function.


H_Tv =

      25
  -----------
  1000 s + 50

Continuous-time transfer function.


H_ev =

           100
  ---------------------
  1000 s^2 + 250 s + 10

Continuous-time transfer function.


H_fdbk =

  1

Static gain.


H =

           100
  ----------------------
  1000 s^2 + 250 s + 110

Continuous-time transfer function.


sys =

  A =
          x1     x2
   x1  -0.25  -0.22
   x2    0.5      0

  B =
        u1
   x1  0.5
   x2    0
```

```
  C =
         x1   x2
   y1    0  0.4

  D =
        u1
   y1   0

Continuous-time state-space model.
```

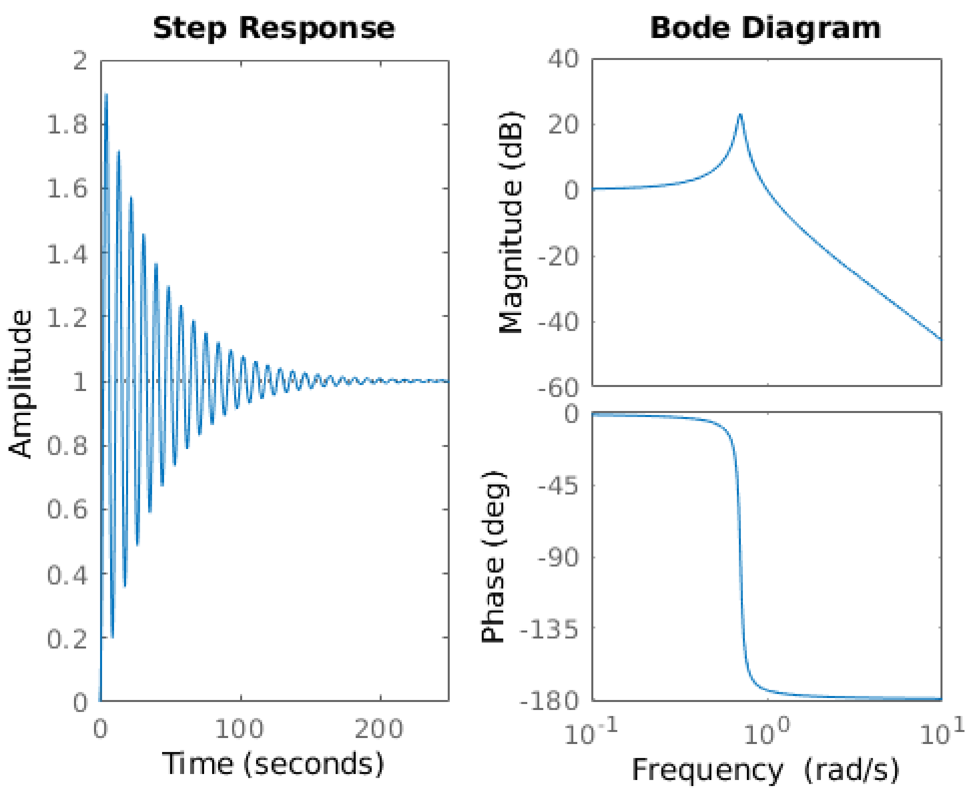


Part d

```
kp = 0.5
ki = 0.1

H_eu = tf([kp, ki], [1, 0])
H_uT = tf(a*T, [1, a])
H_Tv = tf(b, [m, c])
H_fdbk = tf(1, 1)
H = feedback(H_Tv * H_uT * H_eu, H_fdbk)

sys = ss(H)
figure(2); clf;

subplot(1, 2, 1)
step(sys)

subplot(1, 2, 2)
bode(sys)
```

```
kp =

    0.5000


ki =

    0.1000


H_eu =

  0.5 s + 0.1
  -----------
       s

Continuous-time transfer function.


H_uT =

    40
  -------
  s + 0.2

Continuous-time transfer function.


H_Tv =

      25
  -----------
  1000 s + 50

Continuous-time transfer function.


H_fdbk =

  1

Static gain.


H =

            500 s + 100
  --------------------------------
  1000 s^3 + 250 s^2 + 510 s + 100

Continuous-time transfer function.


sys =

  A =
           x1      x2      x3
   x1  -0.25   -0.51   -0.4
   x2      1       0      0
   x3      0    0.25      0
```

```
  B =
       u1
   x1   1
   x2   0
   x3   0

  C =
         x1   x2   x3
   y1     0  0.5  0.4

  D =
       u1
   y1   0

Continuous-time state-space model.
```



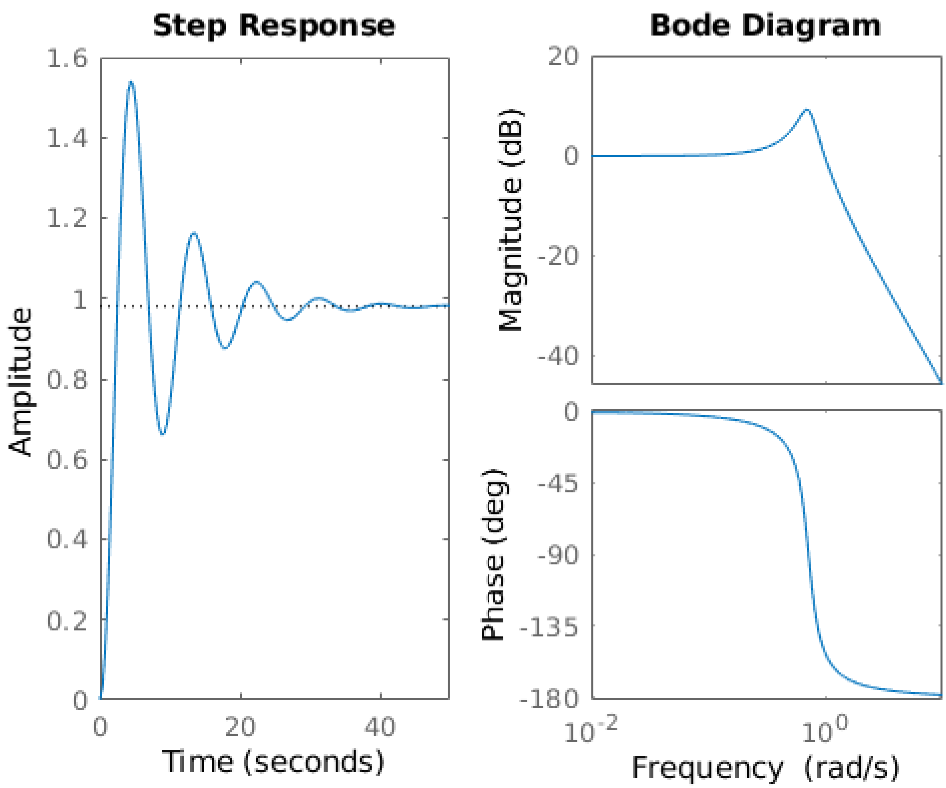
Try using separate transfer functions:

```
H_eu = tf(kp, 1)
H_uT = tf(a*T, [1, a])
H_Tv = tf(b, [m, c])
H_fdbk = tf(1, 1)
H = feedback(H_Tv * H_uT * H_eu, H_fdbk)

%[A, B, C, D] = tf2ss(H)
sys = ss(H)
figure(3); clf;
subplot(1,2,1)
step(sys)
```

```
subplot(1, 2, 2)
bode(sys)
```

```
H_eu =

  0.5

Static gain.


H_uT =

    40
  -------
  s + 0.2

Continuous-time transfer function.


H_Tv =

      25
  -----------
  1000 s + 50

Continuous-time transfer function.


H_fdbk =

  1

Static gain.


H =

           500
  ----------------------
  1000 s^2 + 250 s + 510

Continuous-time transfer function.


sys =

  A =
          x1     x2
   x1  -0.25  -0.51
   x2      1      0

  B =
        u1
   x1  0.5
   x2    0

  C =
       x1  x2
   y1   0   1
```

```
D =
     u1
 y1   0

Continuous-time state-space model.
```



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