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## Table of Contents

Controls Homework 10 Problem 1 .....	1
Controls Homework 10 Problem 2 .....	2
Controls Homework 10 Problem 3 .....	4
Controls Homework 10 Problem 4 .....	5

## Controls Homework 10 Problem 1

```
Gs1 = zpk([], [2 -10 -15 -30], [200]);

X1 = evalfr(Gs1, -2)
K1 = -1/X1

Gc11 = minreal(Gs1*abs(K1) / (1 + Gs1*abs(K1)))

Gs1_2 = zpk([], [0 -8 -20.24 -28.46], [11648]);

X1_2 = evalfr(Gs1_2, -2.3302 + 4.5505i)
K1_2 = -1/X1_2

Gc11_2 = minreal(Gs1_2*abs(K1_2) / (1 + Gs1_2*abs(K1_2)))
roots([1 4.661 26.13])
figure;
step(Gc11_2)
```

$X1 =$

$-0.0172$

$K1 =$

$58.2400$

$Gc11 =$

$$\frac{11648}{(s+28.46)(s+20.24)(s+2.298)(s+2)}$$

*Continuous-time zero/pole/gain model.*

$X1\_2 =$

$-0.6394 + 0.0000i$

---

$K1\_2 =$

$1.5639 + 0.0000i$

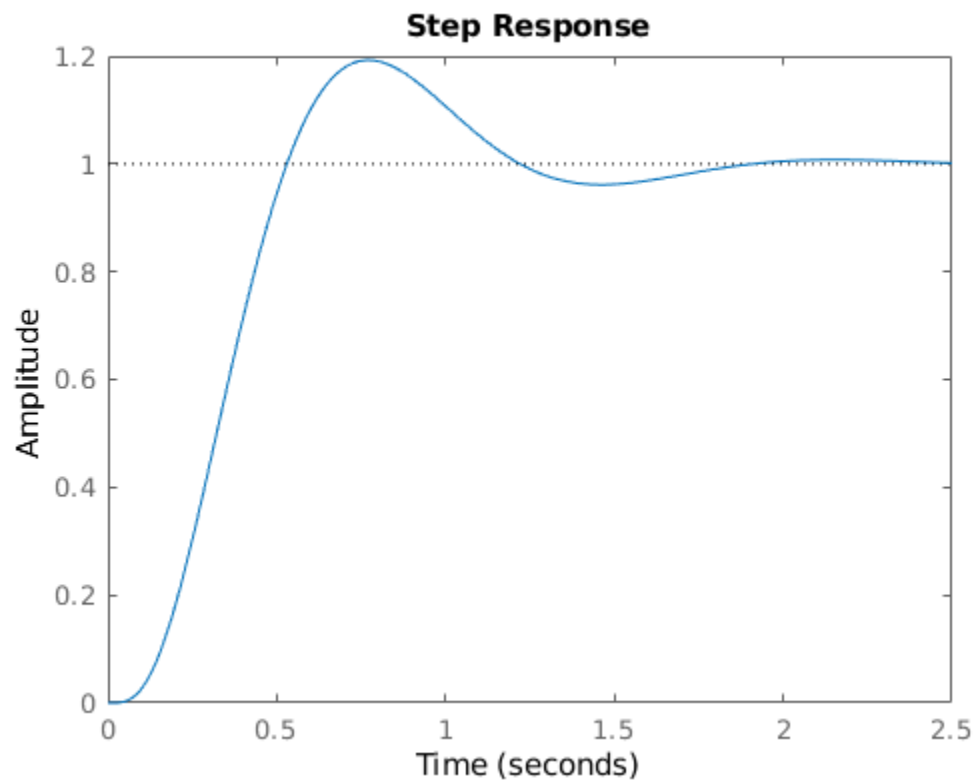
$Gcl1\_2 =$

$$\frac{18216}{(s^2 + 52.04s + 697)(s^2 + 4.66s + 26.14)}$$

*Continuous-time zero/pole/gain model.*

$ans =$

$-2.3305 + 4.5496i$   
 $-2.3305 - 4.5496i$



## Controls Homework 10 Problem 2

$T = .1;$

$s2 = [-2 \ -5 \ -10 \ -15];$

---

```

z2 = exp(s2*T);

Gz2 = zpk([],z2,1);
Gs2 = zpk([],s2,200);
kz2 = evalfr(Gz2, 1);
ks2 = evalfr(Gs2, 0);
k2 = ks2/kz2
Gz2 = zpk([0 0],z2,k2,T)
Gz2tf = tf(Gz2)

figure;
step(Gz2)
hold on
step(Gs2)
hold off

k2 =

    0.0047

Gz2 =

          0.0046701 z^2
-----
(z-0.8187) (z-0.6065) (z-0.3679) (z-0.2231)

Sample time: 0.1 seconds
Discrete-time zero/pole/gain model.

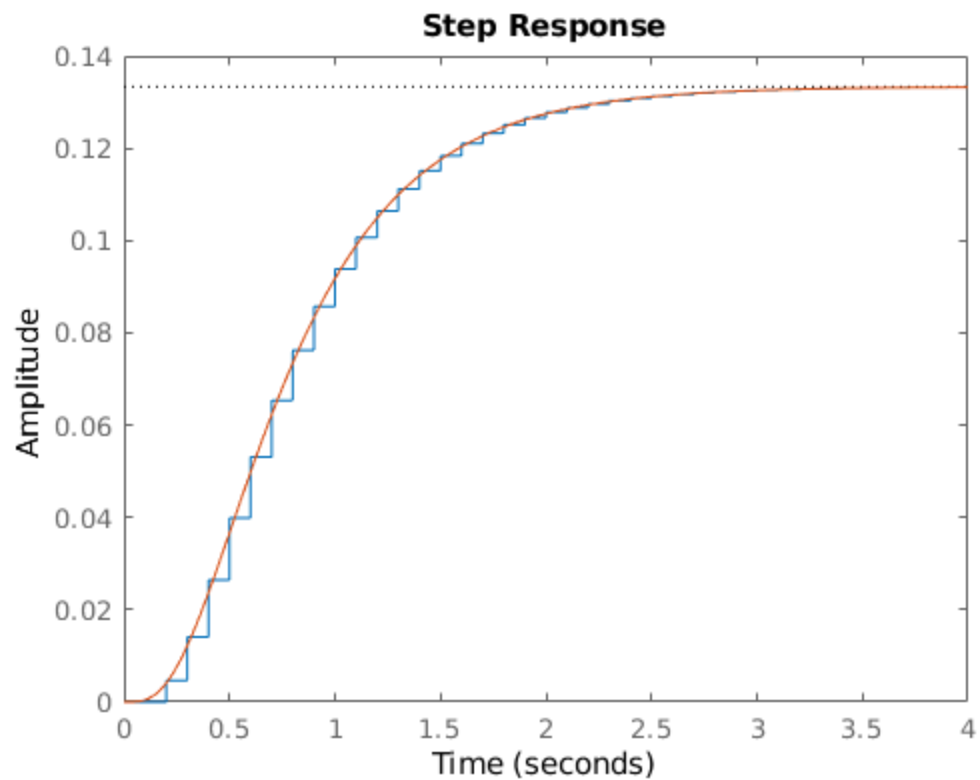
Gz2tf =

          0.00467 z^2
-----
z^4 - 2.016 z^3 + 1.421 z^2 - 0.4105 z + 0.04076

Sample time: 0.1 seconds
Discrete-time transfer function.

```

---



## Controls Homework 10 Problem 3

```
roots3 = roots([1 2 10]);  
s3 = [roots3' -10];  
z3 = exp(s3*T);
```

```
Gz3 = zpk([],z3,1);  
Gs3 = zpk([],s3,200);  
kz3 = evalfr(Gz3, 1);  
ks3 = evalfr(Gs3, 0);  
k3 = ks3/kz3  
Gz3 = zpk([0 0],z3,k3,T)  
Gz3tf = tf(Gz3)
```

```
figure;  
step(Gz3)  
hold on  
step(Gs3)  
hold off
```

```
k3 =
```

```
0.1136
```

---

Gz3 =

$$\frac{0.11363 z^2}{(z-0.3679)(z^2 - 1.729z + 0.8187)}$$

Sample time: 0.1 seconds

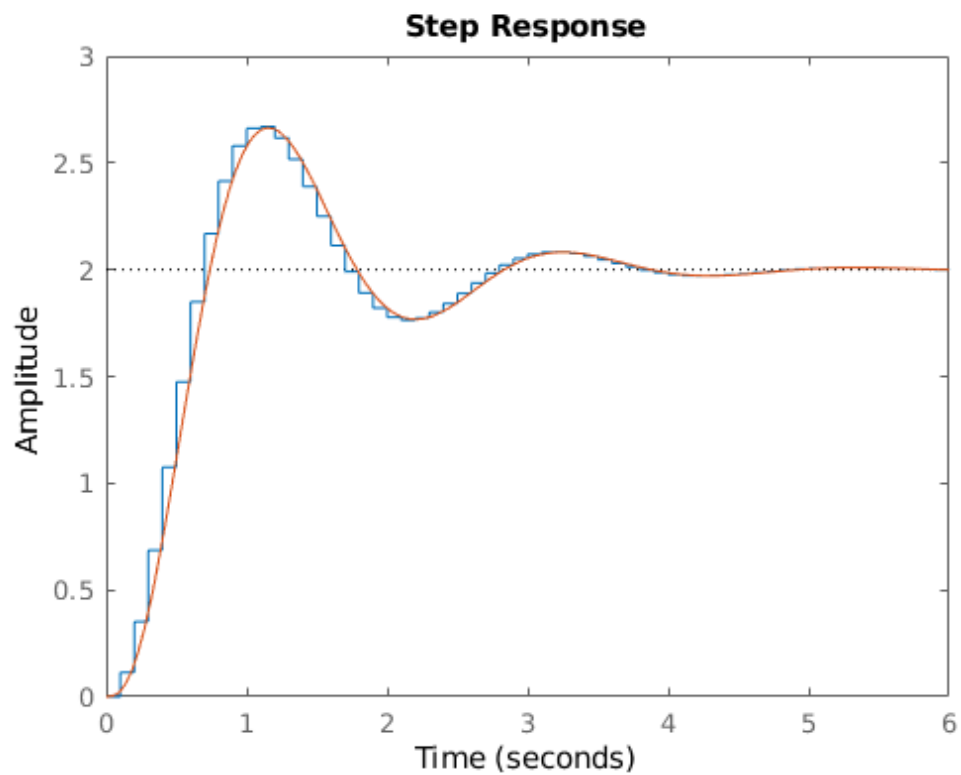
Discrete-time zero/pole/gain model.

Gz3tf =

$$\frac{0.1136 z^2}{z^3 - 2.097 z^2 + 1.455 z - 0.3012}$$

Sample time: 0.1 seconds

Discrete-time transfer function.



## Controls Homework 10 Problem 4

```
s4_poles = [0 -20];  
z4_poles = exp(s4_poles*T);  
s4_zeros = [-2 -5];  
z4_zeros = exp(s4_zeros*T);
```

---

```

Gz4 = zpk(z4_zeros,z4_poles,1);
Gs4 = zpk(s4_zeros,s4_poles,6);
kz4 = evalfr(Gz4, exp(0.01*T));
ks4 = evalfr(Gs4, 0.01);
k4 = ks4/kz4
Gz4 = zpk(z4_zeros,z4_poles,k4,T)
Gz4tf = tf(Gz4)

```

```

figure;
step(Gz4)
hold on
step(Gs4)
hold off

```

$k4 =$

3.6373

$Gz4 =$

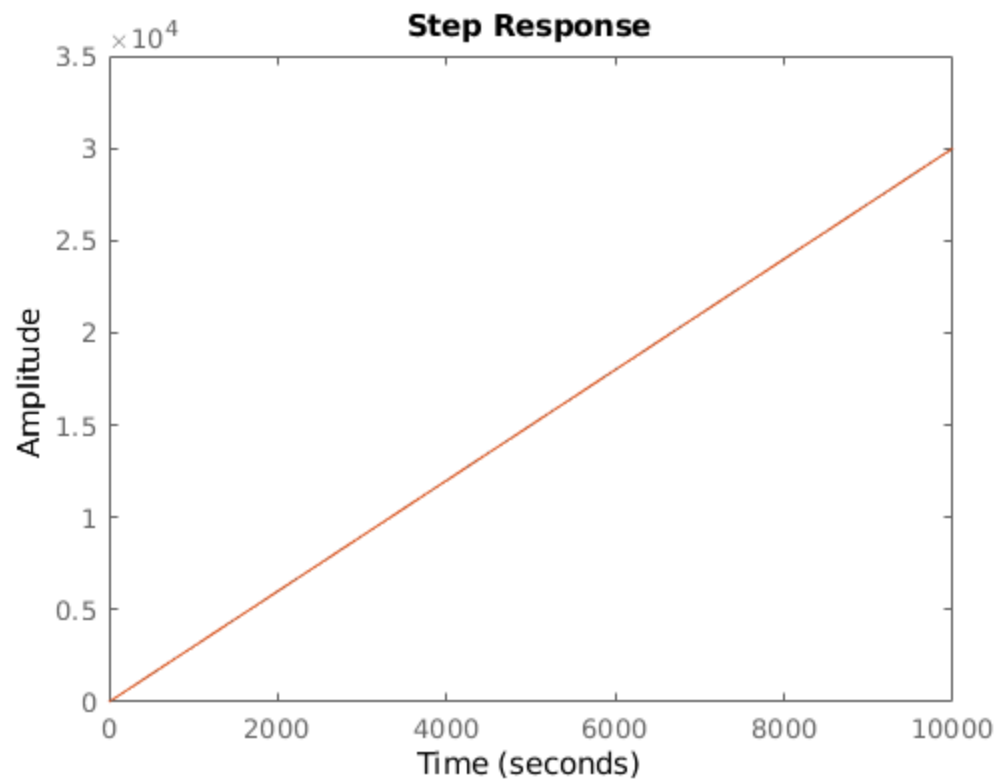
$$\frac{3.6373 (z-0.8187) (z-0.6065)}{(z-1) (z-0.1353)}$$

Sample time: 0.1 seconds  
Discrete-time zero/pole/gain model.

$Gz4tf =$

$$\frac{3.637 z^2 - 5.184 z + 1.806}{z^2 - 1.135 z + 0.1353}$$

Sample time: 0.1 seconds  
Discrete-time transfer function.



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