
```

sys_open = tf([1],[1 2 1 0]);
sys_closed = feedback(sys_open,1,-1)
figure(1)
margin(sys_open)
[Gm,Pm,Wcg,Wcp] = margin(sys_open)
figure(2)
step(sys_closed)
S = stepinfo(sys_closed)

```

```

sys_closed =

```

$$\frac{1}{s^3 + 2s^2 + s + 1}$$

Continuous-time transfer function.

```

Gm =

```

2

```

Pm =

```

21.3877

```

Wcg =

```

1

```

Wcp =

```

0.6823

```

S =

```

```

struct with fields:

```

```

    RiseTime: 1.7271
    SettlingTime: 30.9388
    SettlingMin: 0.6759
    SettlingMax: 1.5435
    Overshoot: 54.3517
    Undershoot: 0
    Peak: 1.5435
    PeakTime: 4.7761

```

```

% Effect of addition on closed loop poles
sys = tf([1], [1 3 6])
p = [-1 -5 -10 -20]
for i=1:4
    sys_new = tf([1], [1 -p(i)])*sys
    subplot(2, 2, i)
    step(sys_new)
    stepinfo(sys_new)
end

```

```
sys =
```

$$\frac{1}{s^2 + 3s + 6}$$

Continuous-time transfer function.

```
p =
```

```
-1    -5    -10   -20
```

```
sys_new =
```

$$\frac{1}{s^3 + 4s^2 + 9s + 6}$$

Continuous-time transfer function.

```
ans =
```

```
struct with fields:
```

```

    RiseTime: 2.0388
    SettlingTime: 4.3619
    SettlingMin: 0.1503
    SettlingMax: 0.1667
    Overshoot: 0
    Undershoot: 0
    Peak: 0.1667
    PeakTime: 12.8484

```

```
sys_new =
```

$$\frac{1}{s^3 + 4s^2 + 9s + 6}$$

$$s^3 + 8s^2 + 21s + 30$$

Continuous-time transfer function.

ans =

struct with fields:

```

    RiseTime: 0.8705
    SettlingTime: 2.6518
    SettlingMin: 0.0301
    SettlingMax: 0.0358
    Overshoot: 7.4106
    Undershoot: 0
    Peak: 0.0358
    PeakTime: 1.8789

```

sys_new =

$$\frac{1}{s^3 + 13s^2 + 36s + 60}$$

Continuous-time transfer function.

ans =

struct with fields:

```

    RiseTime: 0.7990
    SettlingTime: 2.5417
    SettlingMin: 0.0152
    SettlingMax: 0.0181
    Overshoot: 8.4569
    Undershoot: 0
    Peak: 0.0181
    PeakTime: 1.7500

```

sys_new =

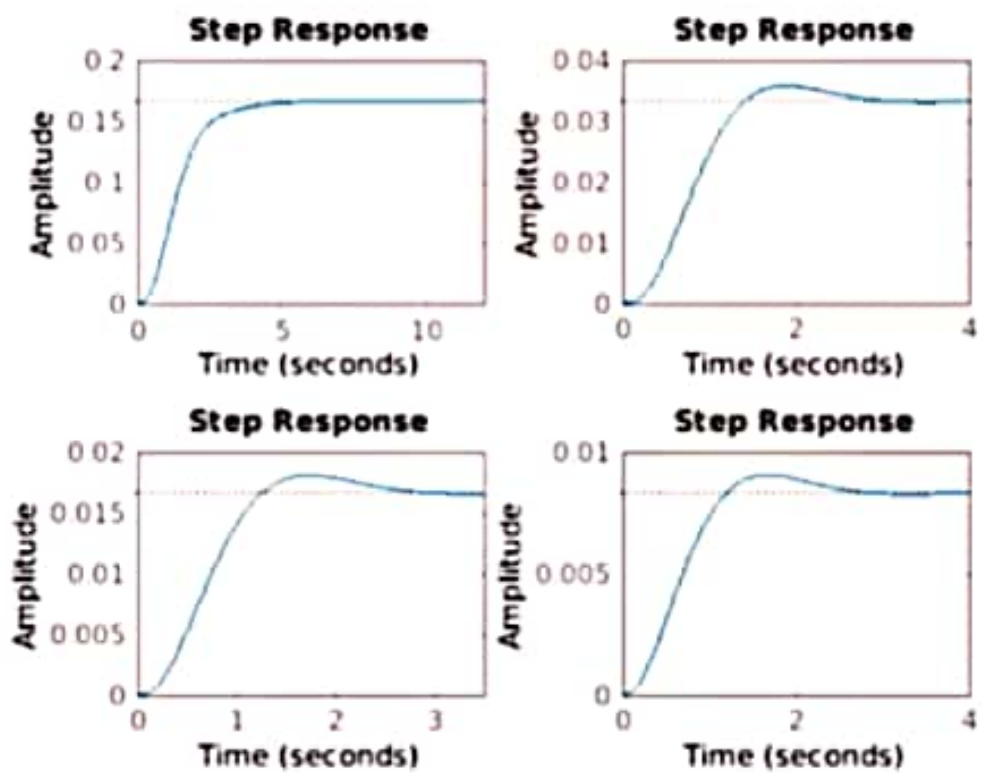
$$\frac{1}{s^3 + 23s^2 + 66s + 120}$$

Continuous-time transfer function.

ans =

struct with fields:

RiseTime: 0.7770
SettlingTime: 2.4869
SettlingMin: 0.0076
SettlingMax: 0.0091
Overshoot: 8.6970
Undershoot: 0
Peak: 0.0091
PeakTime: 1.6886



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```
% Effect of addition on closed loop zeroes
```

```
sys = tf([1], [1 3 6])
```

```
z = [-1 -5 -10 -20]
```

```
for i=1:4
```

```
    sys_new = tf([1 -z(i)], [1])*sys
```

```
    subplot(2, 2, i)
```

```
    step(sys_new)
```

```
    stepinfo(sys_new)
```

```
end
```

```
sys =
```

$$\frac{1}{s^2 + 3s + 6}$$

Continuous-time transfer function.

```
z =
```

-1 -5 -10 -20

```
sys_new =
```

$$\frac{s + 1}{s^2 + 3s + 6}$$

Continuous-time transfer function.

```
ans =
```

```
struct with fields:
```

```
    RiseTime: 0.1658  
    SettlingTime: 3.0252  
    SettlingMin: 0.1508  
    SettlingMax: 0.2867  
    Overshoot: 72.0403  
    Undershoot: 0  
    Peak: 0.2867  
    PeakTime: 0.6754
```

```
sys_new =
```

$$\frac{s + 5}{s^2 + 3s + 6}$$

$$s^2 + 3s + 6$$

Continuous-time transfer function.

ans =

struct with fields:

```

    RiseTime: 0.6366
    SettlingTime: 2.2140
    SettlingMin: 0.7514
    SettlingMax: 0.9198
    Overshoot: 10.3779
    Undershoot: 0
    Peak: 0.9198
    PeakTime: 1.3508

```

sys_new =

$$\frac{s + 10}{s^2 + 3s + 6}$$

Continuous-time transfer function.

ans =

struct with fields:

```

    RiseTime: 0.7398
    SettlingTime: 2.3284
    SettlingMin: 1.5323
    SettlingMax: 1.8183
    Overshoot: 9.0973
    Undershoot: 0
    Peak: 1.8183
    PeakTime: 1.5044

```

sys_new =

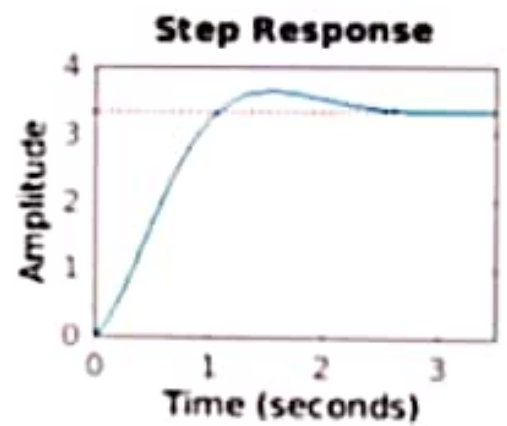
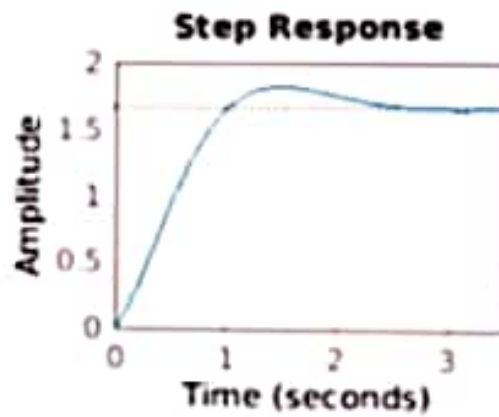
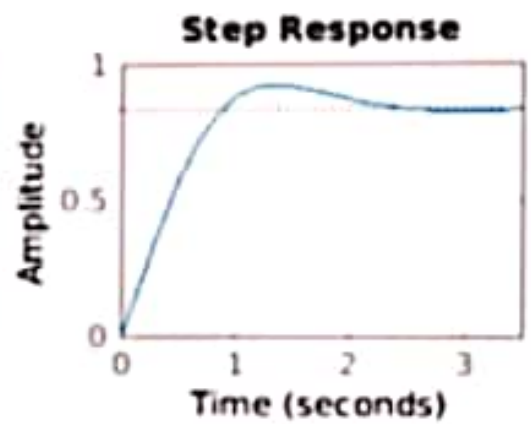
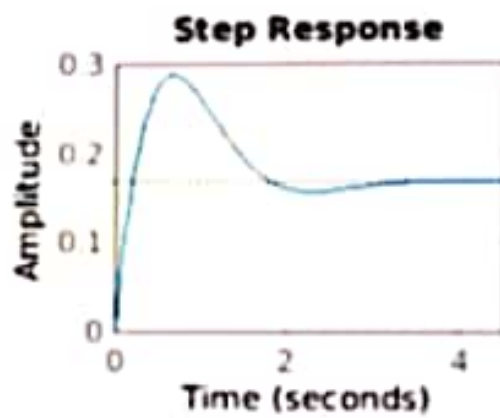
$$\frac{s + 20}{s^2 + 3s + 6}$$

Continuous-time transfer function.

ans =

struct with fields:

RiseTime: 0.7623
SettlingTime: 2.3834
SettlingMin: 3.0030
SettlingMax: 3.6282
Overshoot: 0.8459
Undershoot: 0
Peak: 3.6282
PeakTime: 1.5658



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