First order system Lab 1

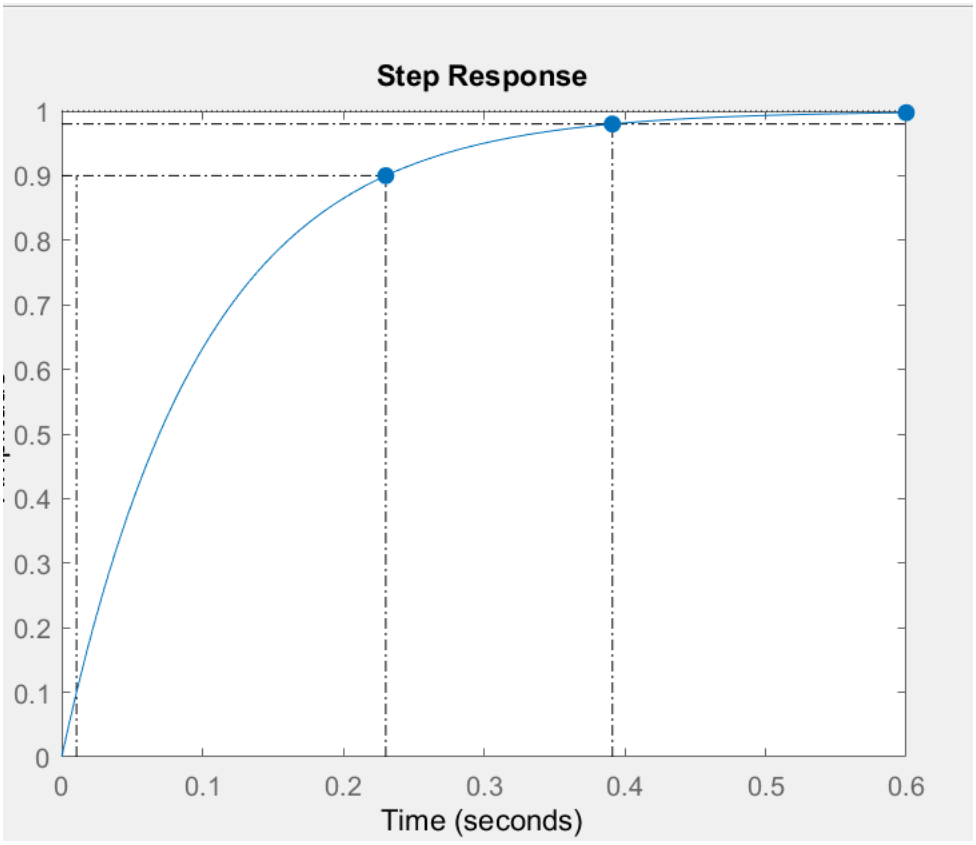
-→step response

Case 1 : (Time constant =0.1)

```
K = 1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [0.1 1];
G = tf(num,den);
step(G)
[y, t] = step(G);
info = stepinfo(y, t);
hold on
```

1x1 struct with 9 fields

Field	Value
RiseTime	0.2171
TransientTime	0.3774
SettlingTime	0.3774
SettlingMin	0.9000
SettlingMax	0.9970
Overshoot	0
Undershoot	0
Peak	0.9970
PeakTime	0.5803



→When the time constant was 0.01 the rise time = 0.22 and the settling time = 0.3717

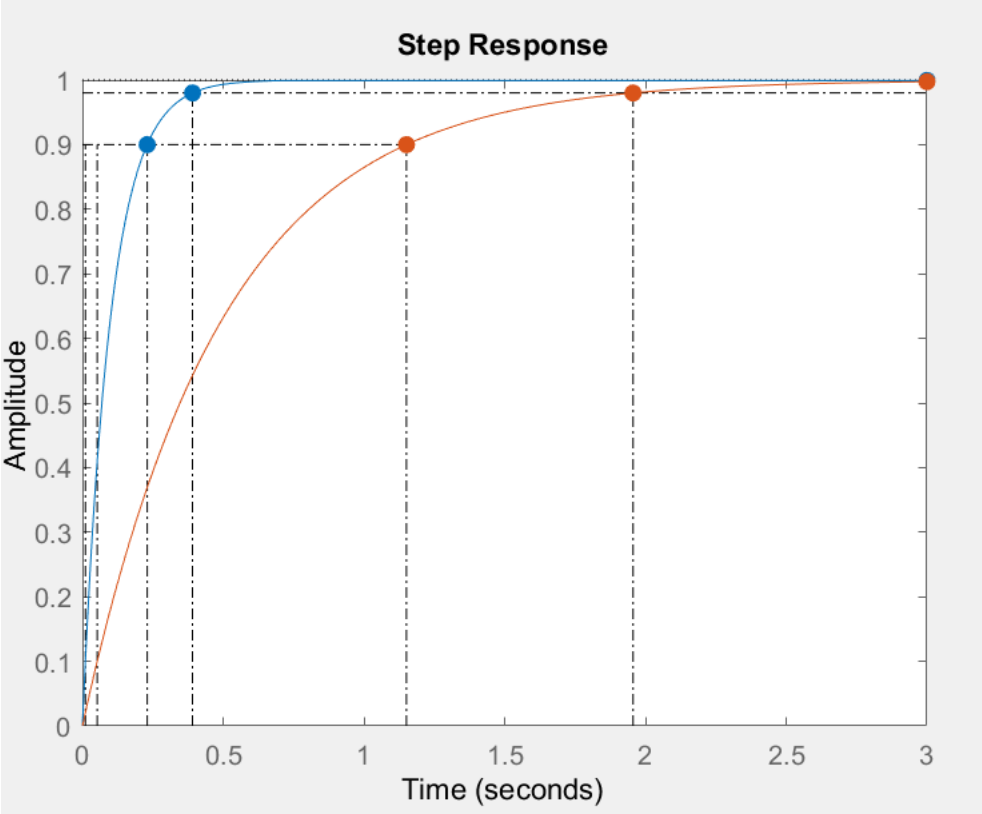
Case 2 : (time constant = 0.5)

```
K = 1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [0.5 1];
G = tf(num,den);
step(G)
[y, t] = step(G);
info = stepinfo(y, t);
hold on
```

info

1x1 struct with 9 fields

Field	Value
RiseTime	1.0854
TransientTime	1.8870
SettlingTime	1.8870
SettlingMin	0.9000
SettlingMax	0.9970
Overshoot	0
Undershoot	0
Peak	0.9970
PeakTime	2.9013



→When the time constant increased to 0.5 the rise time = 1.1 and the settling time = 1.88 which increased from the first case which indicates that the time constant has an effect on rise time and settling time also the response is slow.

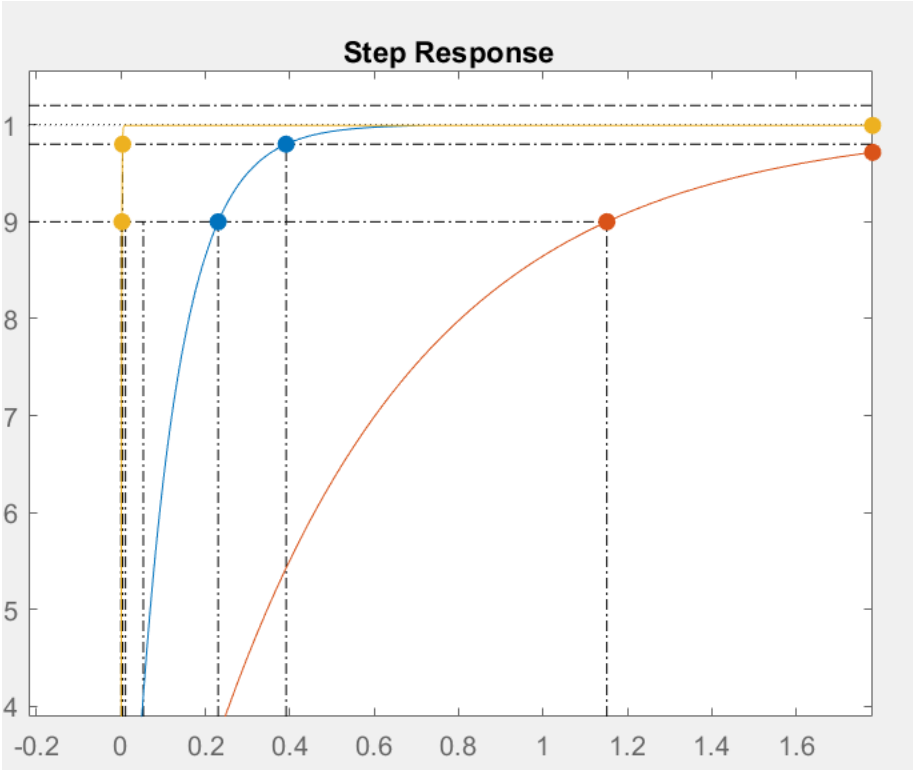
Case 3: (time constant = 0.001)

```
K = 1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
step(G)
[y, t] = step(G);
info = stepinfo(y, t);
hold on
```

info

1x1 struct with 9 fields

Field	Value
RiseTime	0.0022
TransientTime	0.0038
SettlingTime	0.0038
SettlingMin	0.9000
SettlingMax	0.9970
Overshoot	0
Undershoot	0
Peak	0.9970
PeakTime	0.0058

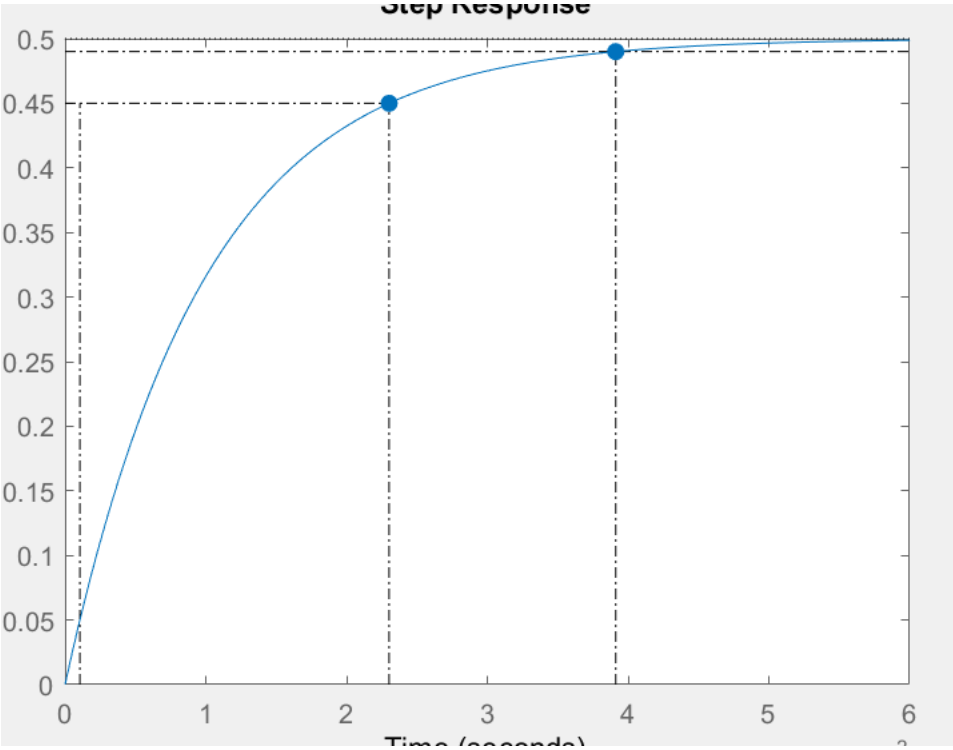


-→when the time constant decreased to 0.001 the rise time is 0.0022 and settling time is 0.00391 in which the response is faster which indicate time constant has an greater effect on the response of the system.

Case 4: (Gain k =0.5)

```
K = 0.5;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
step(G)
[y, t] = step(G);
info = stepinfo(y, t);
hold on
```

Field	Value
RiseTime	0.0022
TransientTime	0.0038
SettlingTime	0.0038
SettlingMin	0.4500
SettlingMax	0.4985
Overshoot	0
Undershoot	0
Peak	0.4985
PeakTime	0.0058



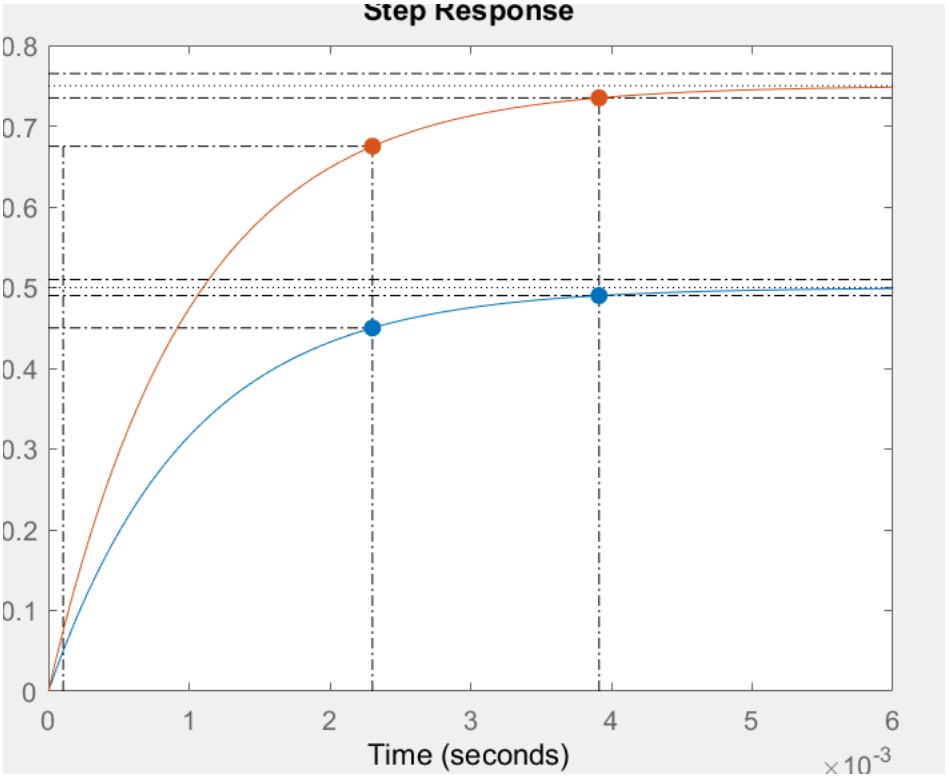
→when the gain value is 0.5 the rise time is 0.0022 and the settling time is 0.0038

Case 5: (gain k =0.75)

```
K = 0.75;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
step(G)
[y, t] = step(G);
info = stepinfo(y, t);
hold on
```

1x1 struct with 9 fields

Field	Value
RiseTime	0.0022
TransientTime	0.0038
SettlingTime	0.0038
SettlingMin	0.4500
SettlingMax	0.4985
Overshoot	0
Undershoot	0
Peak	0.4985
PeakTime	0.0058



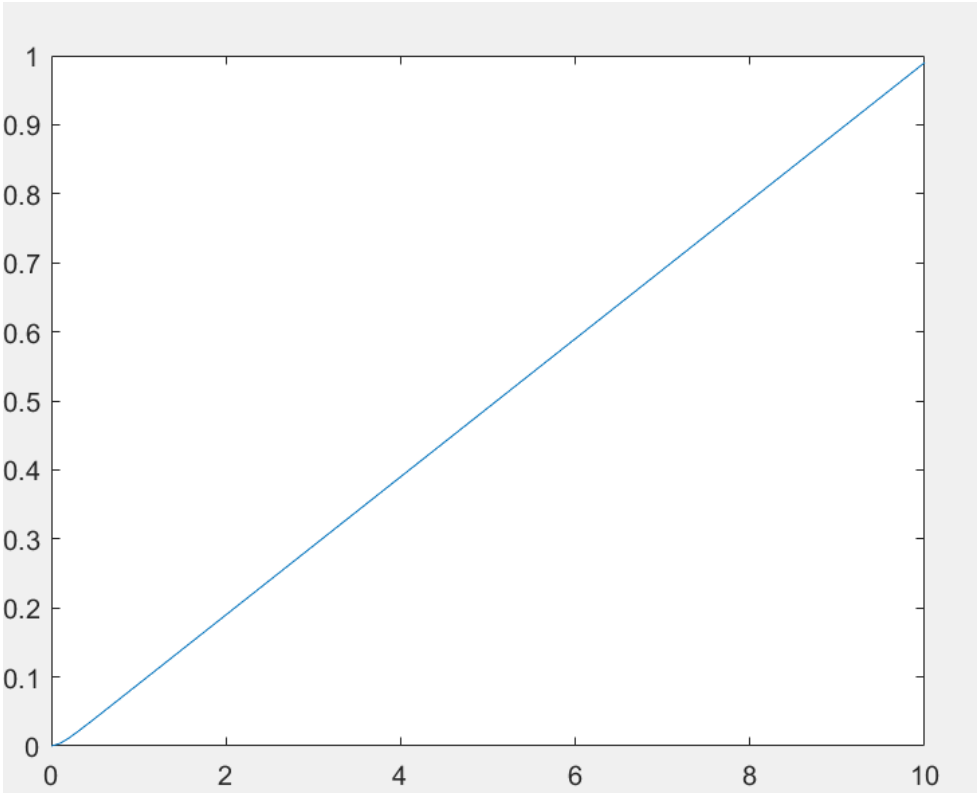
→when the gain increased to 0.75 the rise time and settling time did not affected but the output has been affected in which we can see the response of the system is faster so only the output has been affected.

--->Ramp response

Case 1: (time constant = 0.1)

```
K = 1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [0.1 1];
G = tf(num,den);
t=0:0.1:10;
u_ramp = 0.1 * t;
[y,t]=lsim(G,u_ramp,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

Field	Value
RiseTime	7.9200
TransientTime	9.8020
SettlingTime	9.8020
SettlingMin	0.9000
SettlingMax	0.9900
Overshoot	0
Undershoot	0
Peak	0.9900
PeakTime	10



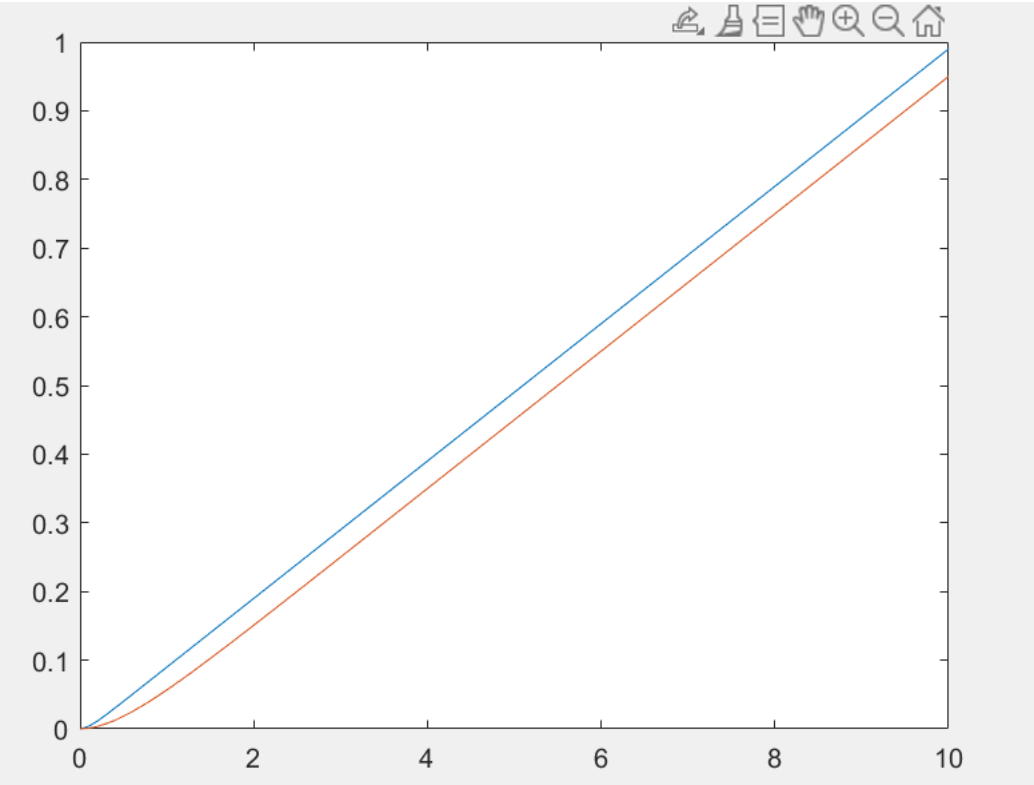
→when ramp response and time constant is 0.1 the rise time=7.92 and settling time = 9.802

Case2 : (time constant = 0.5)

```
K = 1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [0.5 1];
G = tf(num,den);
t=0:0.1:10;
u_ramp = 0.1 * t;
[y,t]=lsim(G,u_ramp,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

1x1 struct with 9 fields

Field	Value
RiseTime	7.6293
TransientTime	9.8100
SettlingTime	9.8100
SettlingMin	0.8600
SettlingMax	0.9500
Overshoot	0
Undershoot	0
Peak	0.9500
PeakTime	10



→when time constant is increased to 0.5 the rise time =7.62 and settling time to 9.81

So the response is slower as in graph and steady state error increases

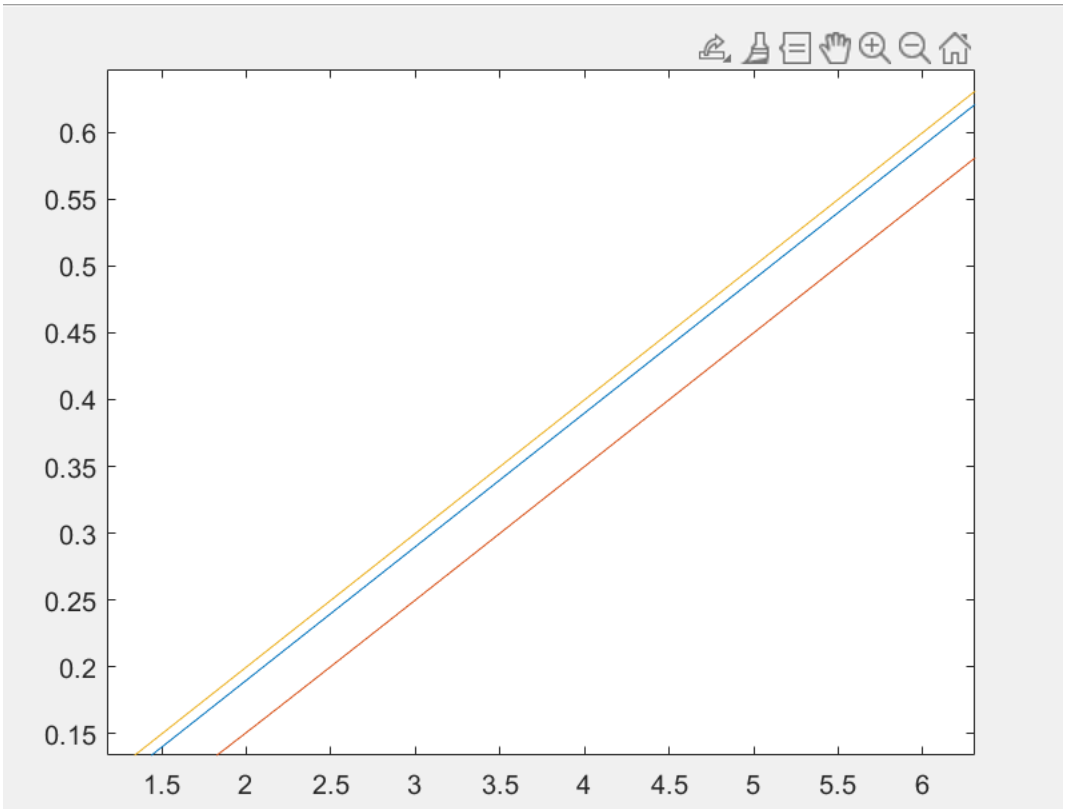
Case 3: (time constant = 0.001)

```
K = 1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
t=0:0.1:10;
u_ramp = 0.1 * t;
[y,t]=lsim(G,u_ramp,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

VARIABLE SELECTION EDIT

1x1 struct with 9 fields

Field	Value
RiseTime	7.9992
TransientTime	9.8000
SettlingTime	9.8000
SettlingMin	0.9099
SettlingMax	0.9999
Overshoot	0
Undershoot	0
Peak	0.9999
PeakTime	10



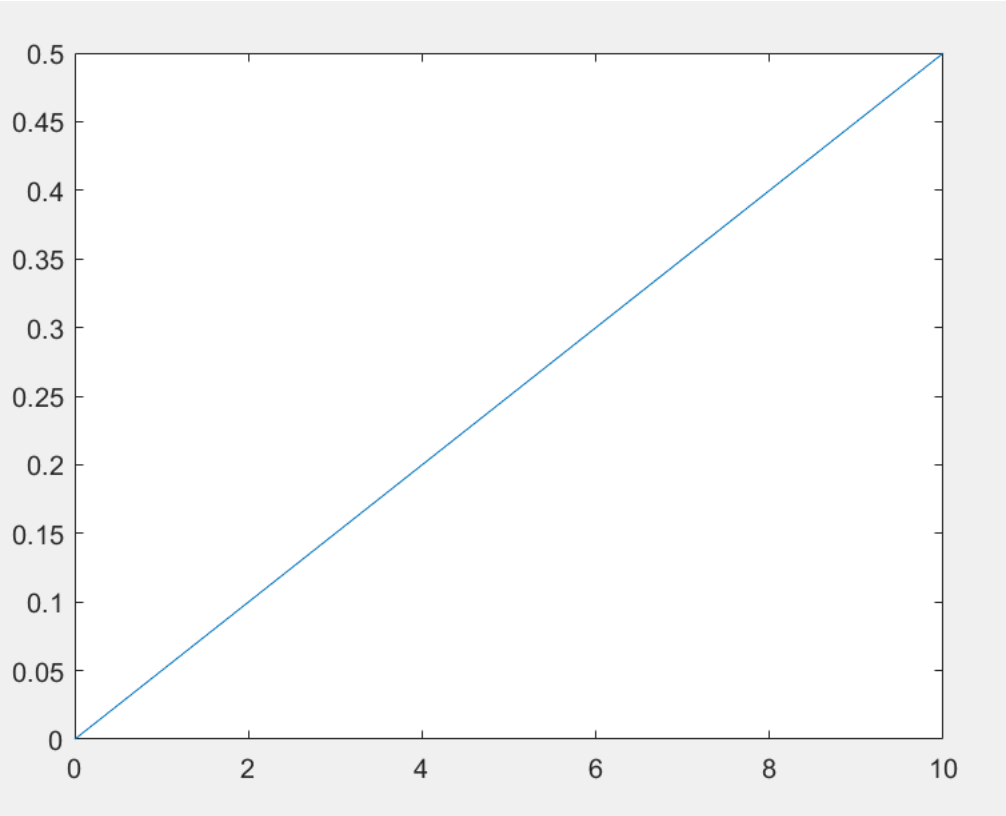
→when time constant decreased the system response increased and steady state error decreased.

Case 4: (Gain k = 0.5)

```
K = 0.5;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
t=0:0.1:10;
u_ramp = 0.1 * t;
[y,t]=lsim(G,u_ramp,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

1x1 struct with 9 fields

Field	Value
RiseTime	7.9992
TransientTime	9.8000
SettlingTime	9.8000
SettlingMin	0.4550
SettlingMax	0.5000
Overshoot	0
Undershoot	0
Peak	0.5000
PeakTime	10



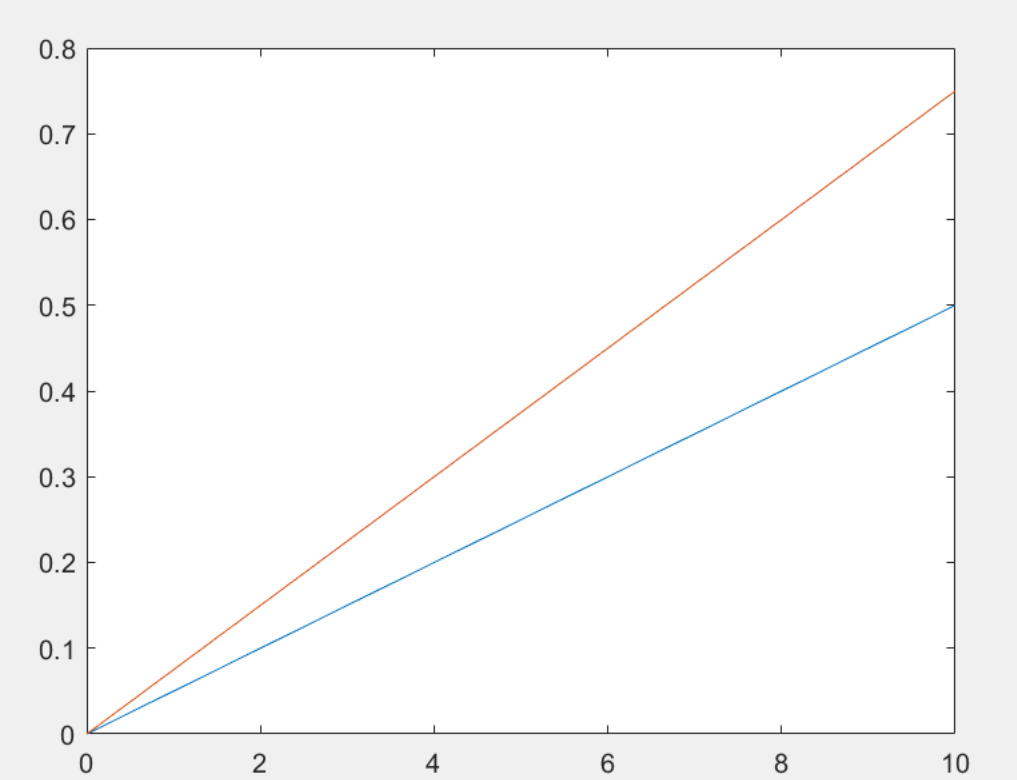
→When the gain is 0.5 the rise time = 7.992 and settling time is 9.800

Case 5:(Gain k = 0.75)

```
K = 0.75;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
t=0:0.1:10;
u_ramp = 0.1 * t;
[y,t]=lsim(G,u_ramp,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

1x1 struct with 9 fields

Field	Value
RiseTime	7.9992
TransientTime	9.8000
SettlingTime	9.8000
SettlingMin	0.6824
SettlingMax	0.7499
Overshoot	0
Undershoot	0
Peak	0.7499
PeakTime	10



→when gain k increased the rise or settling time are not affected but steady state error decreases and system response is faster

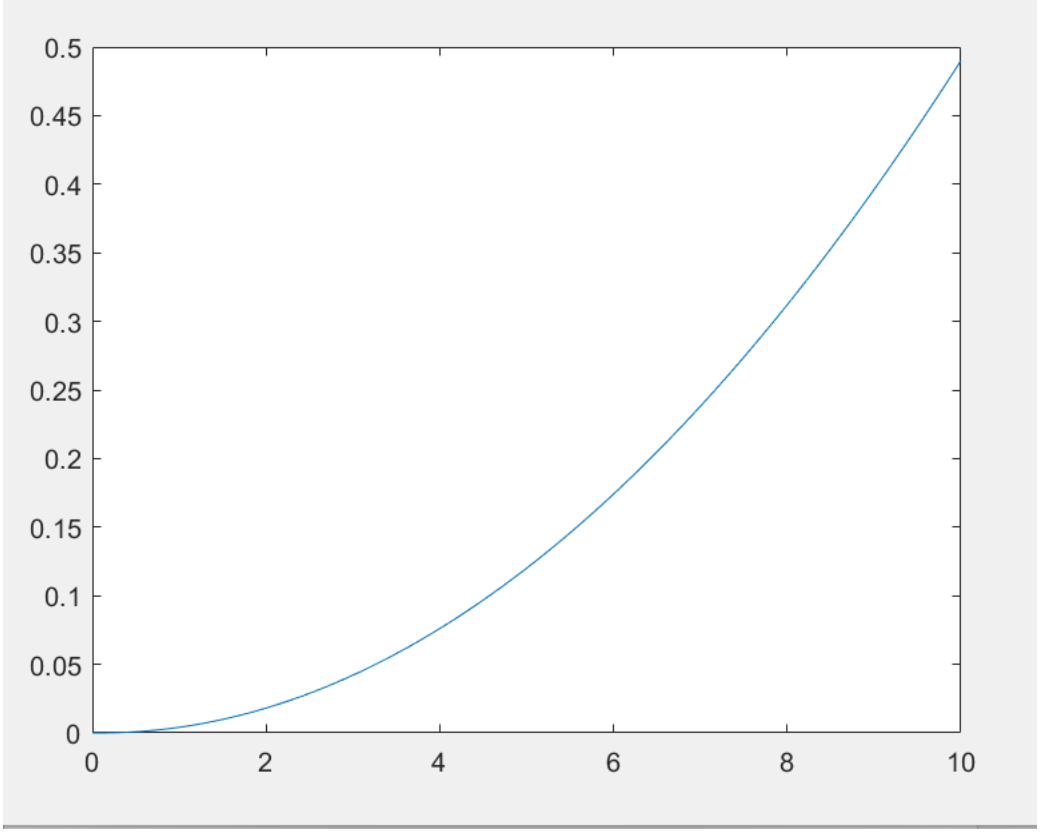
-→Parabolic response

Case 1: (time constant =0.1)

```
K =1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [0.1 1];
G = tf(num,den);
t=0:0.1:10;
u_parabolic = 0.01 * ((t.^2)*0.5)
[y,t]=lsim(G,u_parabolic,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

1x1 struct with 9 fields

Field	Value
RiseTime	6.2632
TransientTime	9.9005
SettlingTime	9.9005
SettlingMin	0.4419
SettlingMax	0.4901
Overshoot	0
Undershoot	0
Peak	0.4901
PeakTime	10



→when the time constant is 0.1 the rise time is 6.26 and settling time is 9.9

Case 2: (time constant =0.5)

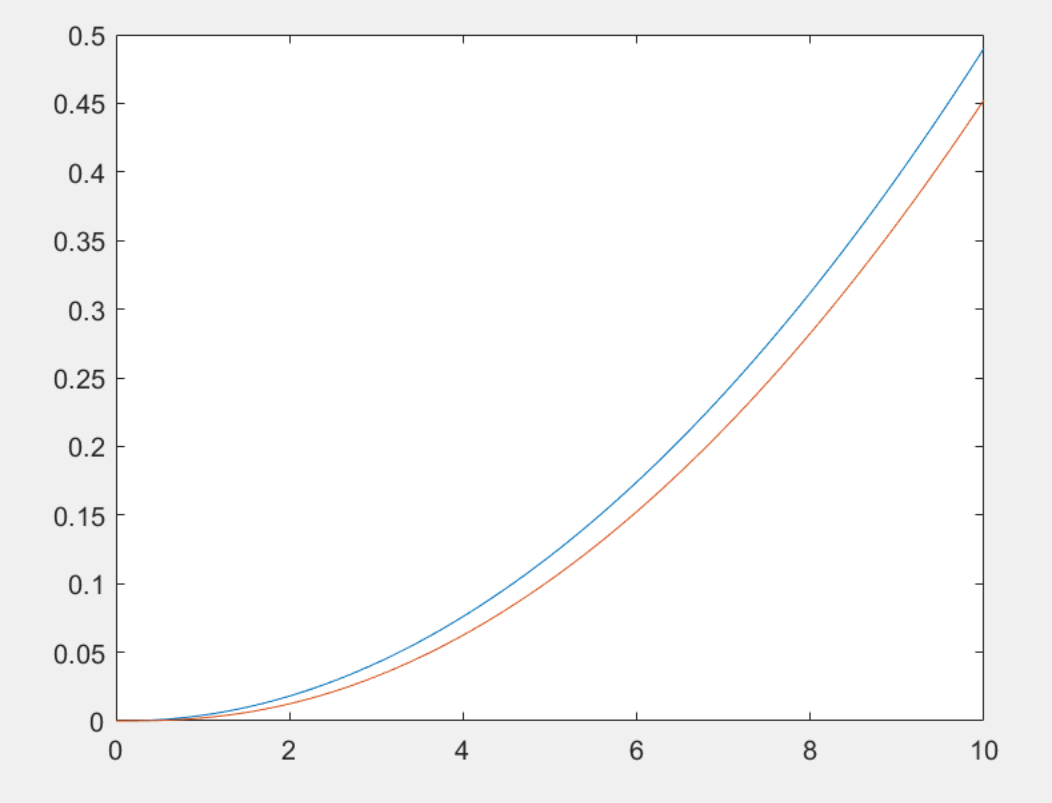
```
K =1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [0.5 1];
G = tf(num,den);
t=0:0.1:10;
u_parabolic = 0.01 * ((t.^2)*0.5)
[y,t]=lsim(G,u_parabolic,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

VARIABLE SELECTION EDIT

1x1 struct with 9 fields

info

Field	Value
RiseTime	6.0451
TransientTime	9.9042
SettlingTime	9.9042
SettlingMin	0.4153
SettlingMax	0.4525
Overshoot	0
Undershoot	0
Peak	0.4525
PeakTime	10



-→here when time constant increased system response faster and steady stater error is infinite error since type 0 system

Case 3: (time constant =0.001)

```
K =1;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
t=0:0.1:10;
u_parabolic = 0.01 * ((t.^2)*0.5)
[y,t]=lsim(G,u_parabolic,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

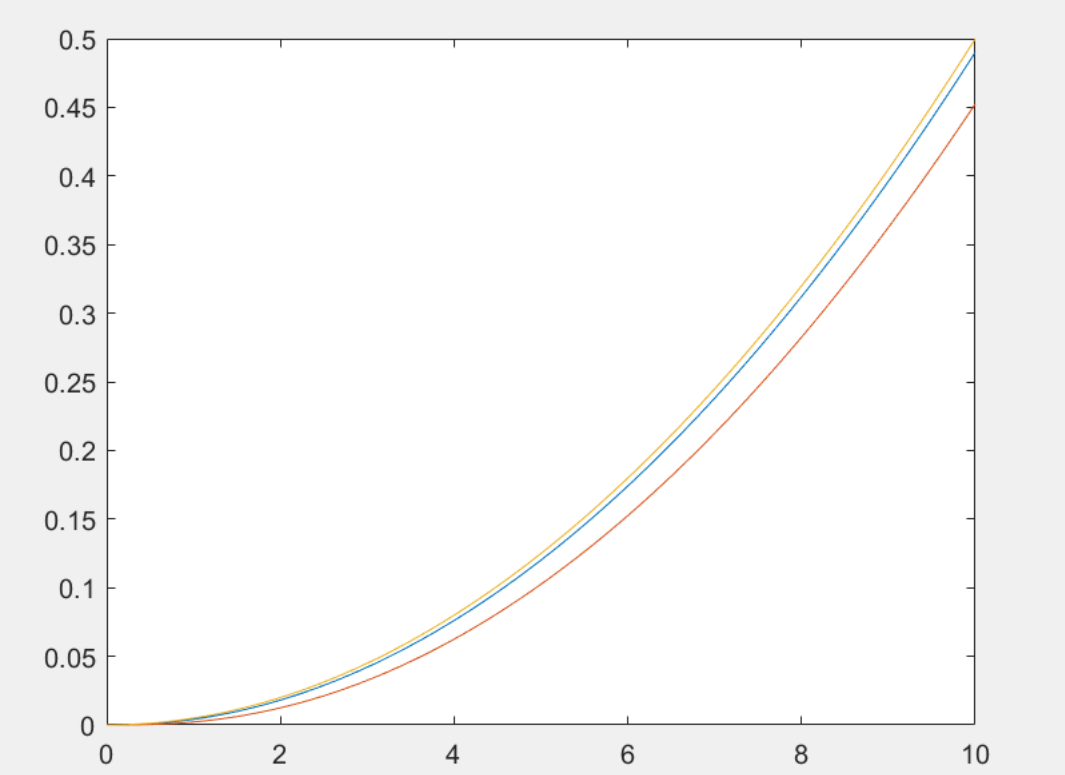
Selection

VARIABLE SELECTION EDIT

1x1 struct with 9 fields

info

Field	Value
RiseTime	6.3242
TransientTime	9.8995
SettlingTime	9.8995
SettlingMin	0.4512
SettlingMax	0.4999
Overshoot	0
Undershoot	0
Peak	0.4999
PeakTime	10



→system response is increased when time constant has decreased to 0.001

Case 4 : (Gain = 0.5)

```
K =0.5;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
t=0:0.1:10;
u_parabolic = 0.01 * ((t.^2)*0.5)
[y,t]=lsim(G,u_parabolic,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

mand Window

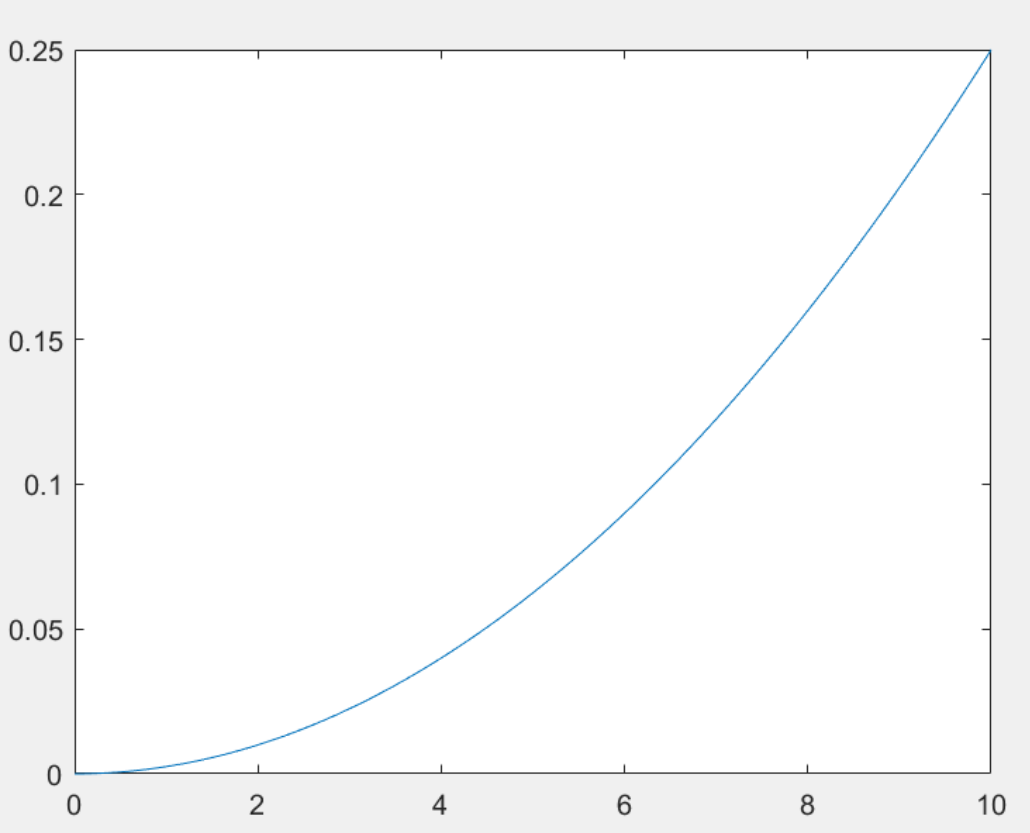
Selection

VARIABLE SELECTION EDIT

1x1 struct with 9 fields

info

Field	Value
RiseTime	6.3242
TransientTime	9.8995
SettlingTime	9.8995
SettlingMin	0.2256
SettlingMax	0.2500
Overshoot	0
Undershoot	0
Peak	0.2500
PeakTime	10



-→when gain k is 0.5 the rise time is 6.32 and settling time is 9.82

Case 5 : (gain = 0.75)

```
K =0.75;
R = 10e3;
C = 1e-7;
T = R * C;
num =[0 K];
den = [T 1];
G = tf(num,den);
t=0:0.1:10;
u_parabolic = 0.01 * ((t.^2)*0.5)
[y,t]=lsim(G,u_parabolic,t);
plot(t,y);
info = stepinfo(y, t);
hold on
```

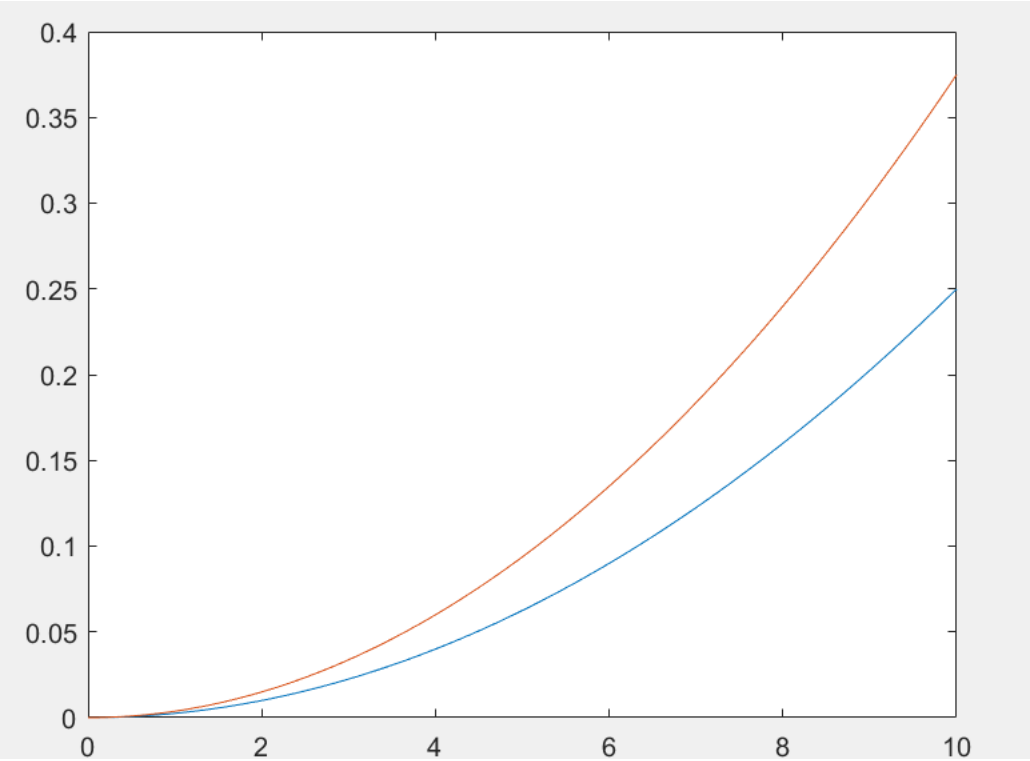
Selection

VARIABLE SELECTION EDIT

1x1 struct with 9 fields

info

Field	Value
RiseTime	6.3242
TransientTime	9.8995
SettlingTime	9.8995
SettlingMin	0.3384
SettlingMax	0.3749
Overshoot	0
Undershoot	0
Peak	0.3749
PeakTime	10



-→system response is faster when gain k increases and the rise time or settling time are uneffected