MATLAB/Simulink Session 2

Part 2

Symbolic Laplace Calculation

```
% laplace with syms
syms t s
laplace(cos(t))
```

ans =

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

```
laplace(sin(t))
```

ans =

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

```
y = t*exp(-t)
```

y = $t\,e^{-t}$

```
laplace(y)
```

ans =

$$\frac{1}{(s+1)^2}$$

```
syms y(t) a
eqn = diff(y,t) == a*y;
y = dsolve(eqn)
```

y = $C_1\,e^{a\,t}$

```
laplace(y)
```

ans =

$$-\frac{C_1}{a-s}$$

Laplace Inverse Calculation

```
% inverse laplace
ilaplace(ans)
```

ans = $C_1\,e^{a\,t}$

```
syms t s
G = 1/(s + 1)
```

G =

$$\frac{1}{s+1}$$

```
ilaplace(G)
```

ans = e^{-t}

Define Laplase: Seccond Method

Note: To plot the step response or calculate DC gain, poles and zeros, use methods below.

```
% another method
s = tf('s')
```

```
s =

  s

Continuous-time transfer function.
```

```
G = 1/(s + 1)
```

```
G =

    1
  -----
  s + 1

Continuous-time transfer function.
```

```
clc;
clear

% 1st method
N = [1 1]
```

```
N = 1×2
     1     1
```

```
D = [1 2 1]
```

```
D = 1×3
     1     2     1
```

```
G1 = tf(N, D)
```

```
G1 =

      s + 1
  -------------
```

```
  s^2 + 2 s + 1

Continuous-time transfer function.
```

```
% 2nd method
s = tf('s')
```

```
s =

  s

Continuous-time transfer function.
```

```
G2 = (s+1)/(s^2 + 2*s + 1)
```

```
G2 =

      s + 1
  -------------
  s^2 + 2 s + 1

Continuous-time transfer function.
```

Poles, Zeros and DC gain of Transfer Functions

```
% poles, zeros, dc gain
zero(G2)
```

```
ans = -1
```

```
pole(G2)
```

```
ans = 2×1
    -1
    -1
```

```
dcgain(G2)
```

```
ans = 1
```

Step Response

```
% step response
s = tf('s')
```

```
s =

  s

Continuous-time transfer function.
```

```
G1 = 1/(s+1)
```

```
G1 =

    1
  -----
```

```
  s + 1

Continuous-time transfer function.
```

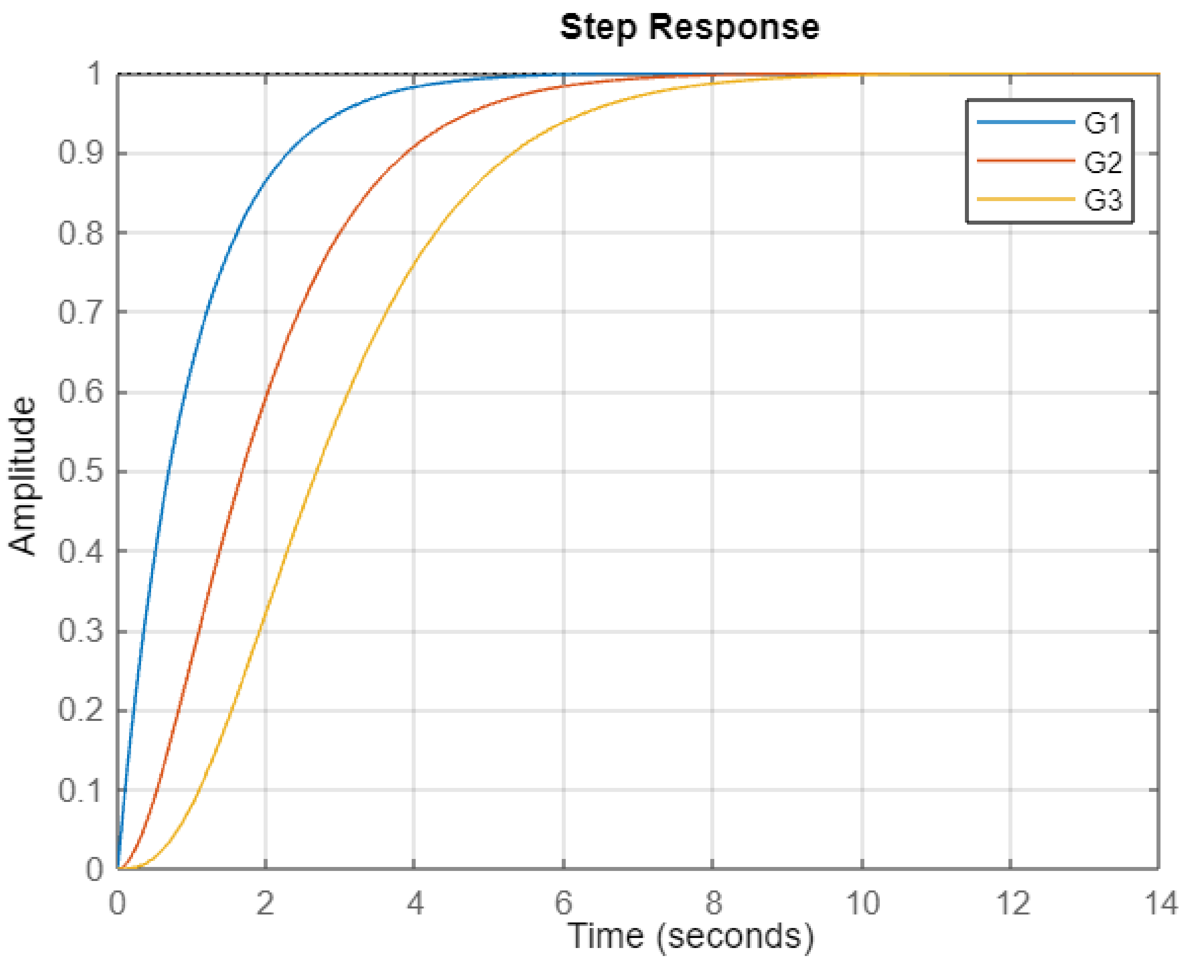
```
G2 = 1/(s+1)^2
```

```
G2 =

        1
  -------------
  s^2 + 2 s + 1

Continuous-time transfer function.
```

```
G3 = 1/(s+1)^3
```

```
G3 =

            1
  ---------------------
  s^3 + 3 s^2 + 3 s + 1

Continuous-time transfer function.
```

```
step(G1)
hold on
step(G2)
step(G3)
grid on
legend
```




```
clc
close all
clear
s = tf('s')
```

```
s =

  s

Continuous-time transfer function.
```

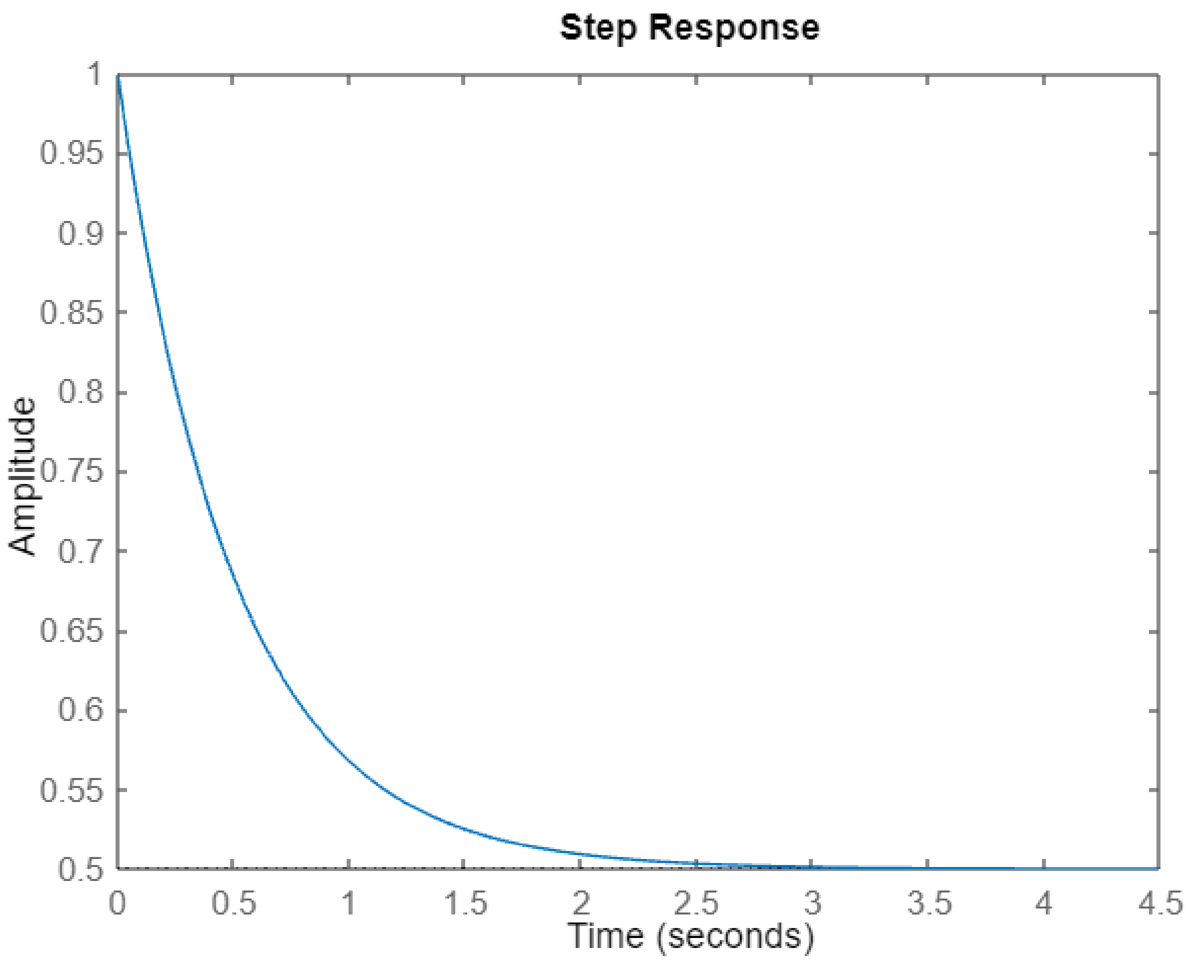
```
H1 = (s+1)/(s+2)
```

```
H1 =

  s + 1
  -----
  s + 2

Continuous-time transfer function.
```

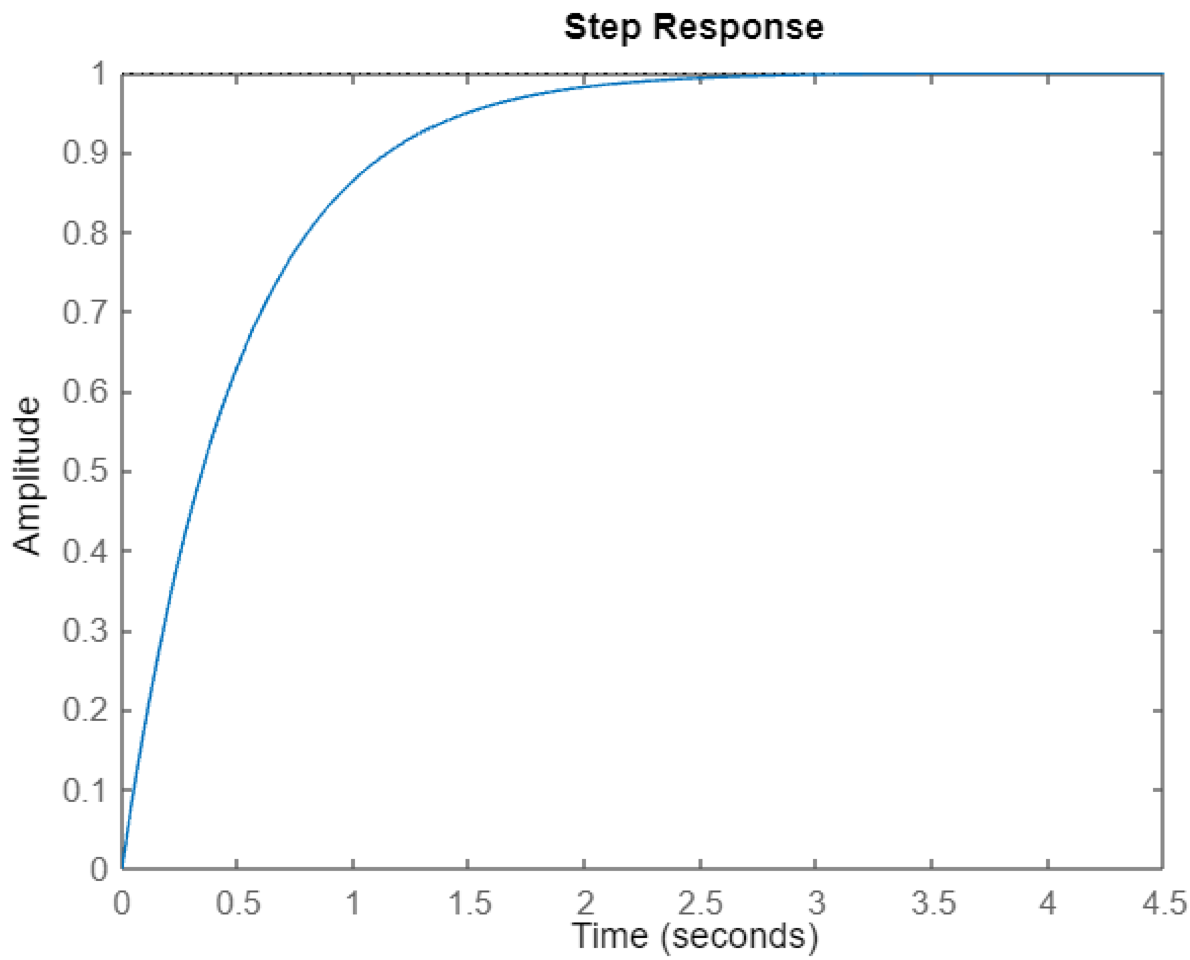
```
H2 = 2/(s+2)
```

```
H2 =

    2
  -----
  s + 2

Continuous-time transfer function.
```

```
step(H1)
```




```
step(H2)
```


Step Response
Amplitude
Time (seconds)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5