Birzeit University-Faculty Of Engineering

Electrical Engineering Department

Signals and Systems –EE2312

MATLAB _Assignment I

Name: Baraa Nasar

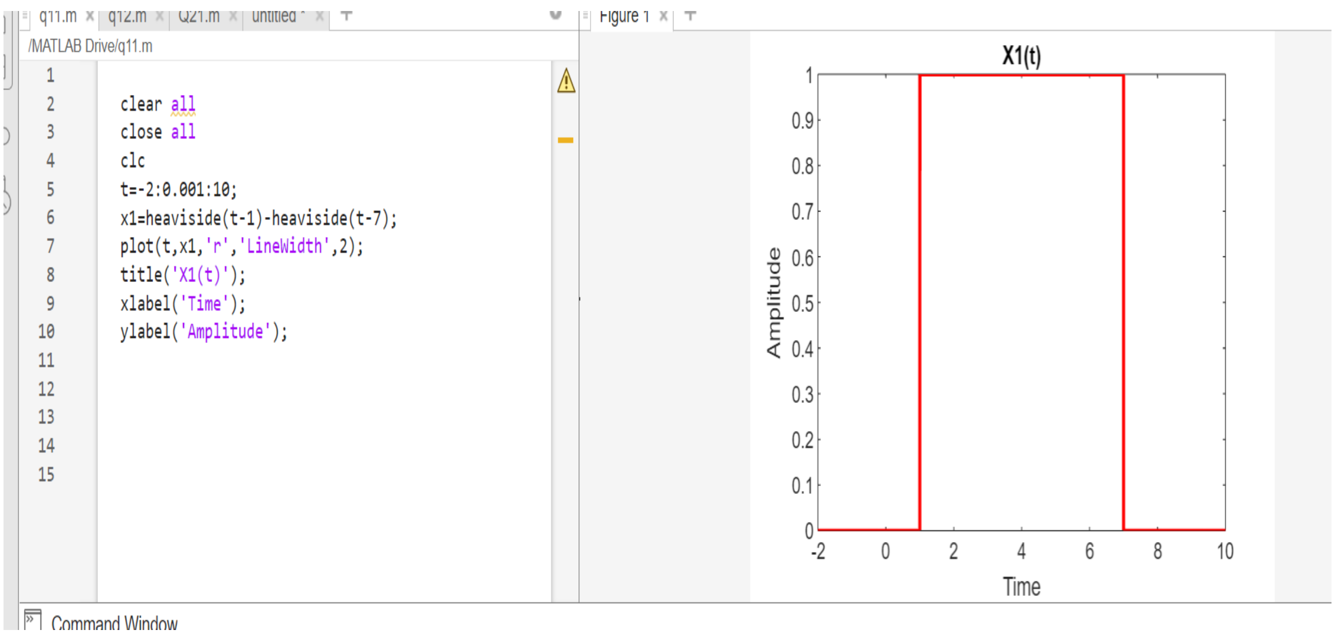
ID: 1210880

Instructor: Dr. Ashraf Al-Rimawi

Question I >> Generate and plot the following signals using MATLAB:

1- X1(t) = u(t-1)- u(t-7)

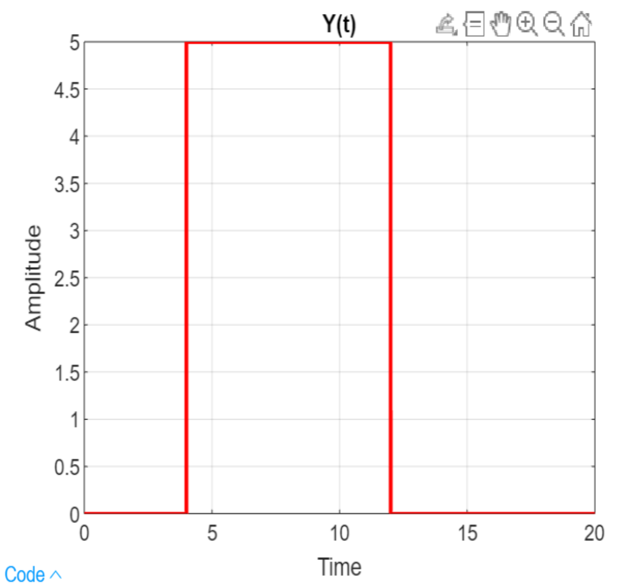
>> Code and Graph:



2- A finite pulse (π(t)) with value = 5 and extension between and center=8

>> Code and Graph:

```
clear all
close all
clc
t=0:0.001:20;
y=5*rectangularPulse(4,12,t);
plot(t,y,'r','LineWidth',2);
title('Y(t)');
xlabel('Time');
ylabel('Amplitude');
```



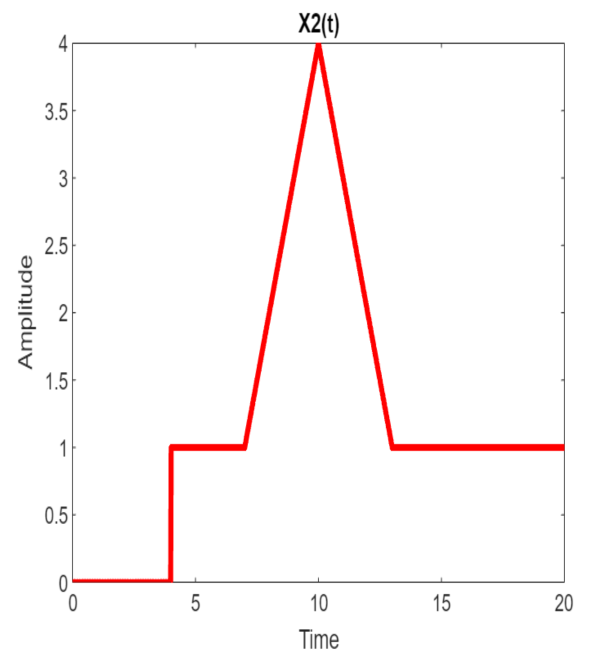
Code ^
grid on

3- X2(t)= u(t-4) +r(t-7)-2r(t-10) +r(t-13) in the time interval [0 20]

>>Code and Graph:

/MATLAB Drive/q12.m

```
clear all
close all
clc
t=0:0.01:20;
u=heaviside(t-4);
r1=(t-7).*heaviside(t-7);
r2=(t-10).*heaviside(t-10);
r3=(t-13).*heaviside(t-13);
x2=u+r1-2*r2+r3;
plot(t,x2,'r','LineWidth',3);
title('X2(t)');
xlabel('Time');
ylabel('Amplitude');
```



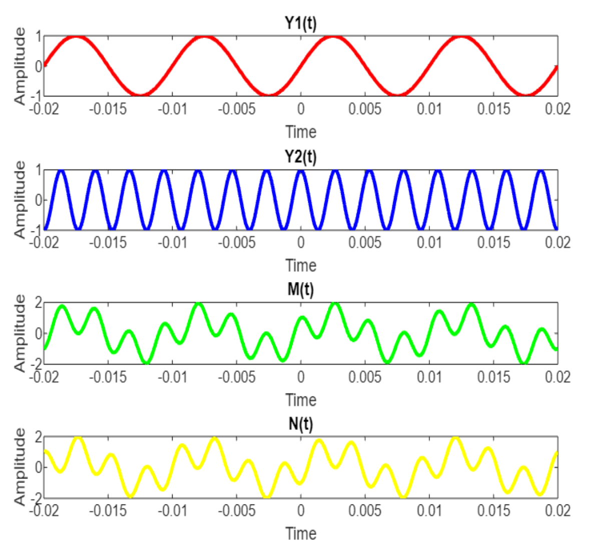
Question II :

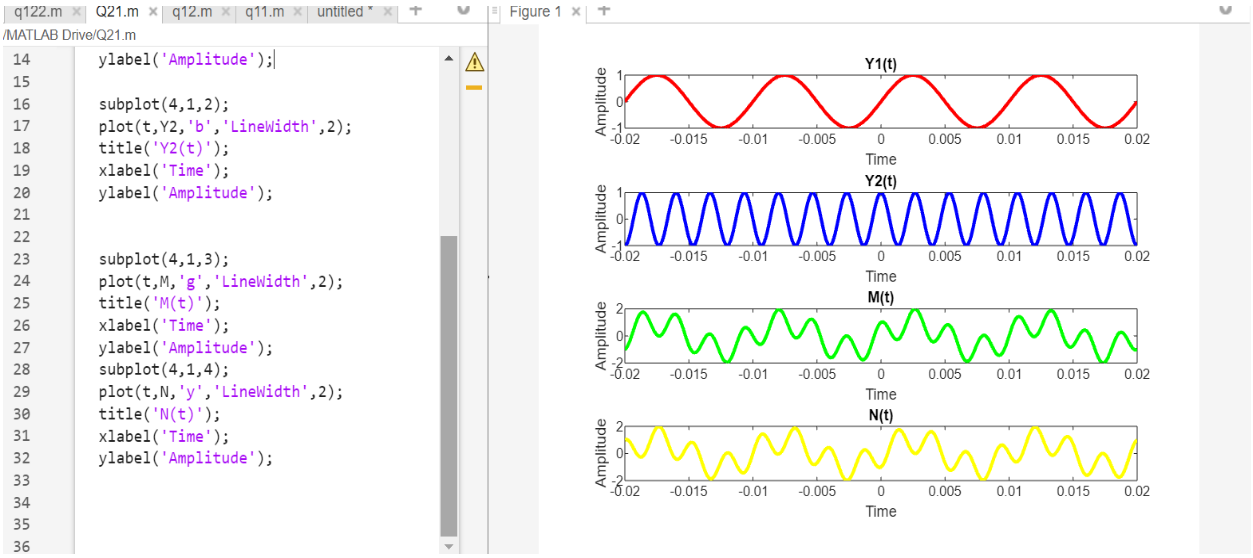
1- Generate and plot the signals y1(t)= sin 200π(t), y2(t)= cos750πt, then determine y1 and plot the signals m(t)= y1+y2 and n(t)= y1-y2.

>>Code and Graph:

/MATLAB Drive/Q21.m

```
clear all
close all
clc
t=-0.02:0.0001:0.02;
Y1=sin(200.*pi.*t);
Y2=cos(750.*pi.*t);
M=Y1+Y2;
N=Y1-Y2;

subplot(4,1,1);
plot(t,Y1,'r','LineWidth',2);
title('Y1(t)');
xlabel('Time');
ylabel('Amplitude');

subplot(4,1,2);
plot(t,Y2,'b','LineWidth',2);
title('Y2(t)');
xlabel('Time');
ylabel('Amplitude');


subplot(4,1,3);
```





2-Determine, using the MATLAB plots, if the sum and/or difference signals are periodic. In case a signal is periodic, determine its fundamental frequency.)

The sum and difference of the signals are periodic and the fundamental frequency is 100HZ

Question III: Write the programs that solve the following differential equations using zero initial conditions.

1- 5 dy(t)/dt + 20y(t) = 15

>>Code and soluation:

/MATLAB Drive/q31.m

```
clear all
close all
clc
syms y(t);
dy(t)=diff(y(t),t);
initial_condition2=y(0)==0;
cond=[initial_condition2];
equation=5*dy(t)+20*y(t)==15;
solution=dsolve(equation,cond)
simple_solution=simplify(solution);
```

Command Window

New to MATLAB? See resources for Getting Started.

```
solution =

3/4 - (3*exp(-4*t))/4

>>
```

2-d 2y(t) /dt 2 + 2 dy dt + 4y(t) = 5 cos1000t.

>>Code and soluation:

AB Drive

q122.m × Q21.m × q12.m × q11.m × q31.m × +

/MATLAB Drive/q31.m

```
clear all
close all
clc
syms y(t);
dy(t)=diff(y,t);
dy2(t)=diff(y,t,2);
initial_condition1=y(0)==0;
initial_condition2=dy(0)==0;
equation= dy2(t)+2*dy(t)+4*y(t)==5*cos(1000*t);
solution=dsolve(equation,initial_condition1,initial_condition2)
simple_solution=simplify(solution);
```

```
solution =

sin(3^(1/2)*t)*((625*cos(1000*t - 3^(1/2)*t))/124999500002 -
(625*cos(1000*t + 3^(1/2)*t))/124999500002 - (1249995*sin(1000*t +
3^(1/2)*t))/499998000008 + (1249995*sin(1000*t -
3^(1/2)*t))/499998000008 + (1250005*3^(1/2)*cos(1000*t +
3^(1/2)*t))/1499994000024 + (1250005*3^(1/2)*cos(1000*t -
3^(1/2)*t))/1499994000024 + (312499375*3^(1/2)*sin(1000*t +
3^(1/2)*t))/374998500006 + (312499375*3^(1/2)*sin(1000*t -
3^(1/2)*t))/374998500006) - (5*3^(1/2)*cos(3^(1/2)*t)*((sin(t*(3^(1/2)
- 1000)) - cos(t*(3^(1/2) - 1000))*(3^(1/2) - 1000))/((3^(1/2) -
1000)^2
+ 1) + (sin(t*(3^(1/2) + 1000)) - cos(t*(3^(1/2) + 1000))*(3^(1/2) +
1000))/((3^(1/2) + 1000)^2 + 1)))/6 - (1250005*3^(1/2)*exp(-
t)*sin(3^(1/2)*t))/749997000012 - (1249995*exp(-
t)*cos(3^(1/2)*t))/(4*(500*3^(1/2) - 250001)*(500*3^(1/2) + 250001))
```

Question IV: Write the programs that determine the response of the linear time invariant system to the given input and the given initial conditions:

1-dy(t) /dt + 2y(t) = 7u(t) $y(0) = 2;$

>>Code and soluation:

```
clear all
close all
clc
syms y(t);
dy(t)=diff(y(t),t);
initial_condition1=y(0)==2;
equation=dy(t)+2*y(t)==7*heaviside(t);
solution=dsolve(equation,initial_condition1)
simple_solution=simplify(solution);
```

Command Window

New to MATLAB? See resources for Getting Started.

```
solution =

exp(-2*t)/4 - exp(-2*t)*((7*sign(t))/4 - (7*exp(2*t)*(sign(t) + 1))/4)

>>
```

2-d 2y(t)/ dt2 + 4 dy /dt + 5y(t) = 5 cos2000t (y (0) =1, y' (0) =2);

>>Code and soluation:

```
clear all
close all
clc
syms y(t);
dy(t)=diff(y,t);
dy2(t)=diff(y,t,2);
initial_condition1=y(0)==1;
initial_condition2=dy(0)==2;
equation=dy2(t)+4*dy(t)+5*y(t)==5*cos(2000*t);
solution=dsolve(equation,initial_condition1,initial_condition2)
simple_solution=simplify(solution);
```

Solution=

sin(t)*(cos(1999*t)/799201 + cos(2001*t)/800801 + (1999
sin(1999*t))/1598402 + (2001*sin(2001*t))/1601602) - cos(t)
((1999*cos(1999*t))/1598402 - (2001*cos(2001*t))/1601602-
sin(1999*t)/799201 + sin(2001*t)/800801) + (640001760000*exp(-
2*t)*cos(t))/640000960001 + (2560002240002*exp(-
2*t)*sin(t))/640000960001

Question V: Use Simulink (MATLAB) to simulate the following systems then show and plot the step response of the system.

1-5 d 4 $y(t)$/ dt 4 + 8 $dy(t)$ /dt + 2$y(t)$ = 4 d 2 $x(t)$ /dt 2 − 12$x(t)$

Solution:

1. $5\frac{d^4y(t)}{dt^4} + 8\frac{dy(t)}{dt} + 2y(t) = 4\frac{d^2x(t)}{dt^2} - 12x(t)$

$$\frac{d^4y(t)}{dt^4} + 1.6\frac{dy(t)}{dt} + 0.4y(t) = 0.8\frac{d^2x(t)}{dt^2} - 2.4x(t)$$

$a_0 = 0.4, a_1 = 1.6, b_0 = -2.4, b_1 = 0.8$

$$\frac{d^4y(t)}{dt^4} + 1.6\frac{dy(t)}{dt} - 0.8\frac{d^2x(t)}{dt^2} = \underbrace{-0.4y(t) - 2.4x(t)}_{q_0}$$

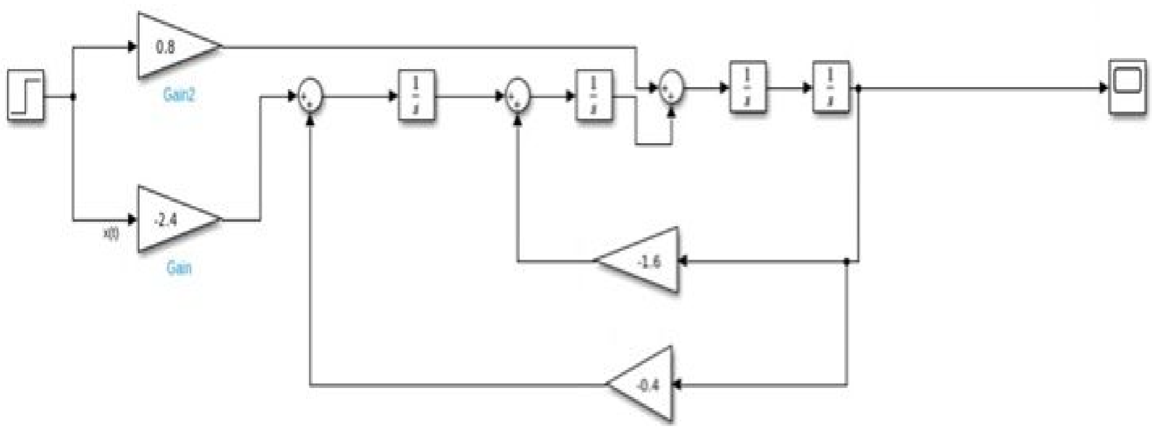
$$\frac{d^3y(t)}{dt^3} - 0.8\frac{dx(t)}{dt} = \int \underbrace{q_0 - 1.6y(t)}_{q_1}$$

$$\frac{d^2y(t)}{dt^2} = \int \underbrace{q_1 + 0.8x(t)}_{q_2}$$

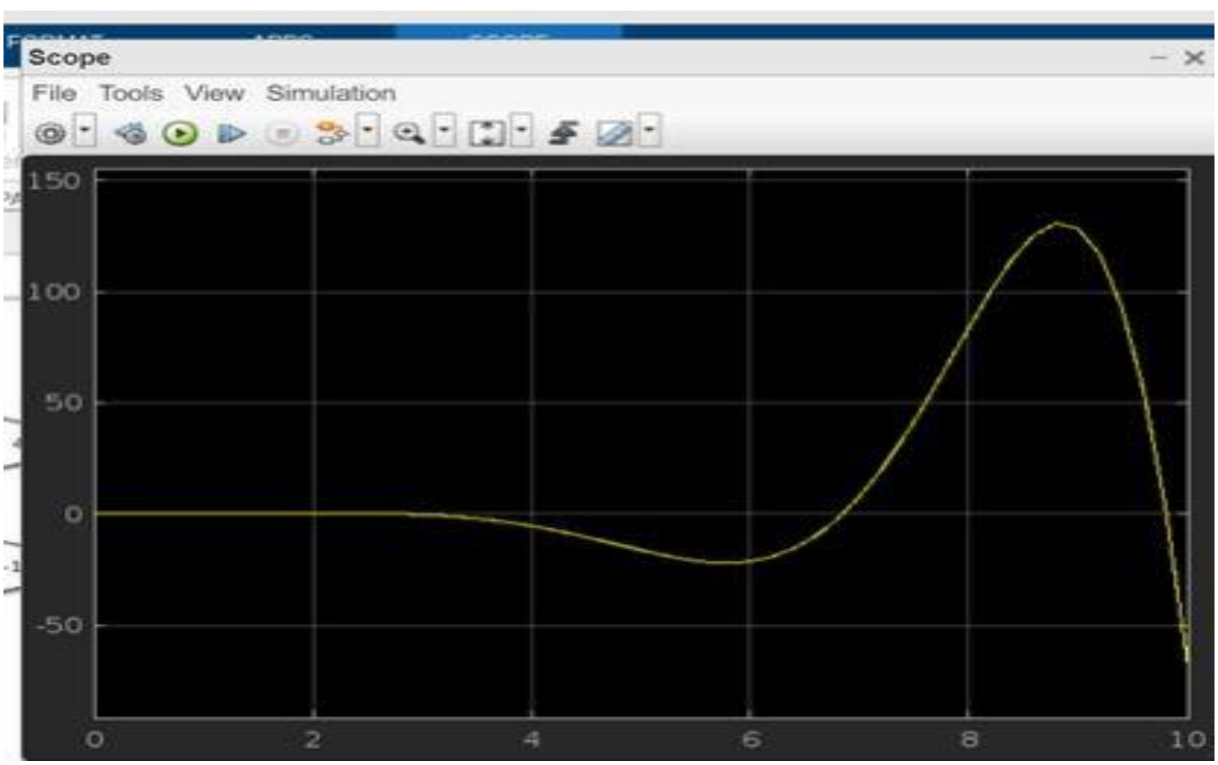
$$\frac{dy(t)}{dt} = \int q_2$$

$$y(t) = \int\int q_2$$

Simulation:



Graph:



2-d 2y(t) /dt 2 + 2 dy /dt + 4y(t) = 5 $x(t)$

Solution:

2. $\frac{d^2y(t)}{dt^2} + 2\frac{dy}{dt} + 4y(t) = 5x(t)$

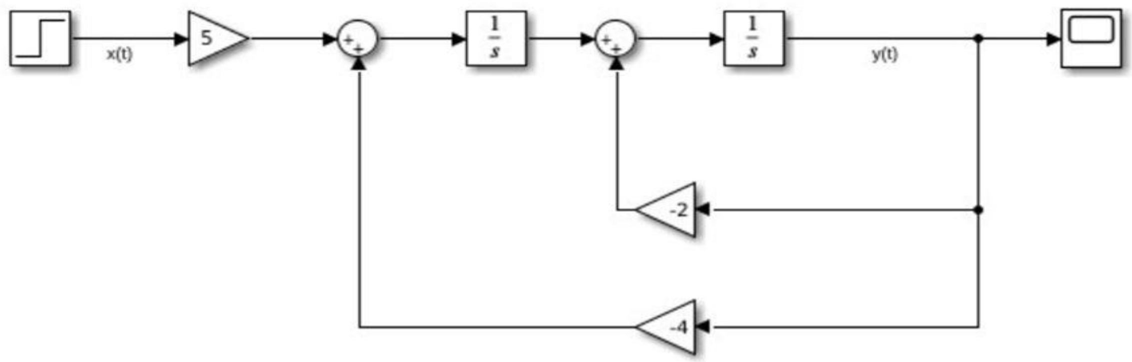
$a_0 = 4 , a_1 = 2 , b_0 = 5$

$$\frac{d^2y(t)}{dt^2} + 2\frac{dy}{dt} = \underbrace{5x(t) - 4y(t)}_{q_0}$$

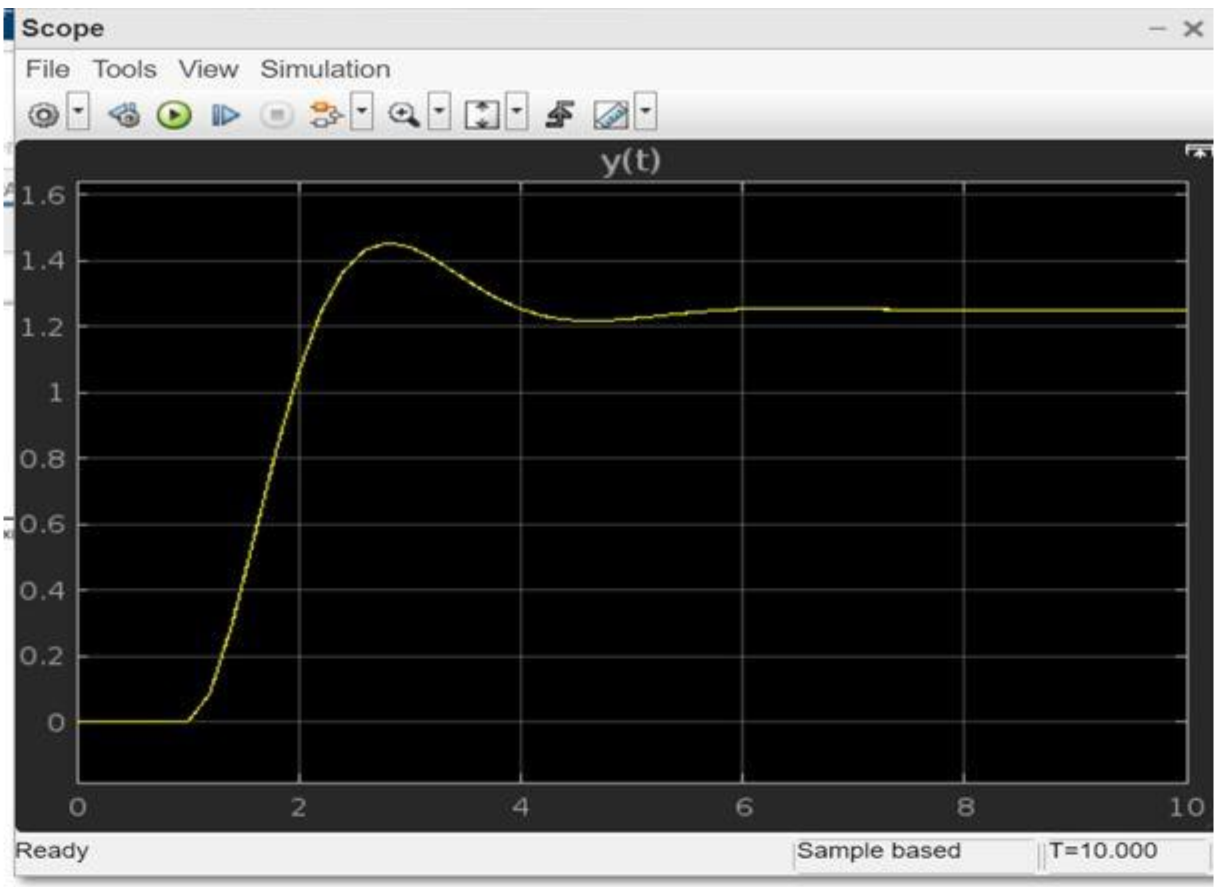
$$\frac{dy(t)}{dt} = \int \underbrace{q_0 - 2y(t)}_{q_1}$$

$$y(t) = \int q_1$$

Simulation:



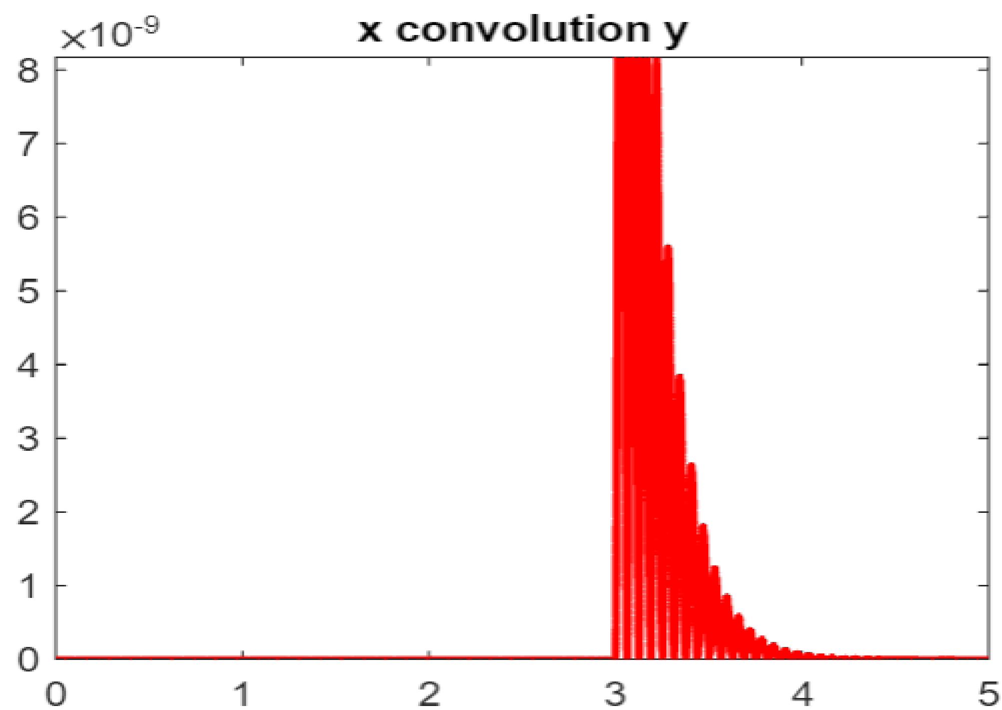
Graph:



Question VI: Write a program that computes and plots the convolution of the functions $x(t)$ = (10e −6t)π((t-2)/4), $y(t)$ = (10e −6t cos 100t) π((t-6)/6

>>Code and Graph:

```
clear all
close all
clc
syms toe t
x=10.*exp(-6*toe).*rectangularPulse(0,4,toe);
y=10.*exp(-6*(t-toe)).*cos(100*(t-toe)).*rectangularPulse(3,9,t-toe);
conv_ans=int(x*y,toe,-inf,inf)
fplot(conv_ans,[0 5],'r','LineWidth',2);
title('x convolution y');
```



>> Solution:

conv_ans =

$$\mathrm{heaviside}(t-3)\,e^{-6t}\,(\sin(100\,t)-\sin(300))-\mathrm{heaviside}(t-9)\,e^{-6t}\,(\sin(100\,t)-\sin(900))+\mathrm{heaviside}(t-7)\,e^{-6t}\,(\sin(300)-\sigma_1$$

where

$$\sigma_1=\sin(100\,t-400)$$

023a/matlab/MatricesAndArraysGSExample/MatricesAndArraysGSExample.mlx

$$00))-\mathrm{heaviside}(t-9)\,e^{-6t}\,(\sin(100\,t)-\sin(900))+\mathrm{heaviside}(t-7)\,e^{-6t}\,(\sin(300)-\sigma_1)-\mathrm{heaviside}(t-13)\,e^{-6t}\,(\sin(900)-\sigma_1)$$

Question VII: Write a program that computes and plots the spectral representation of the function

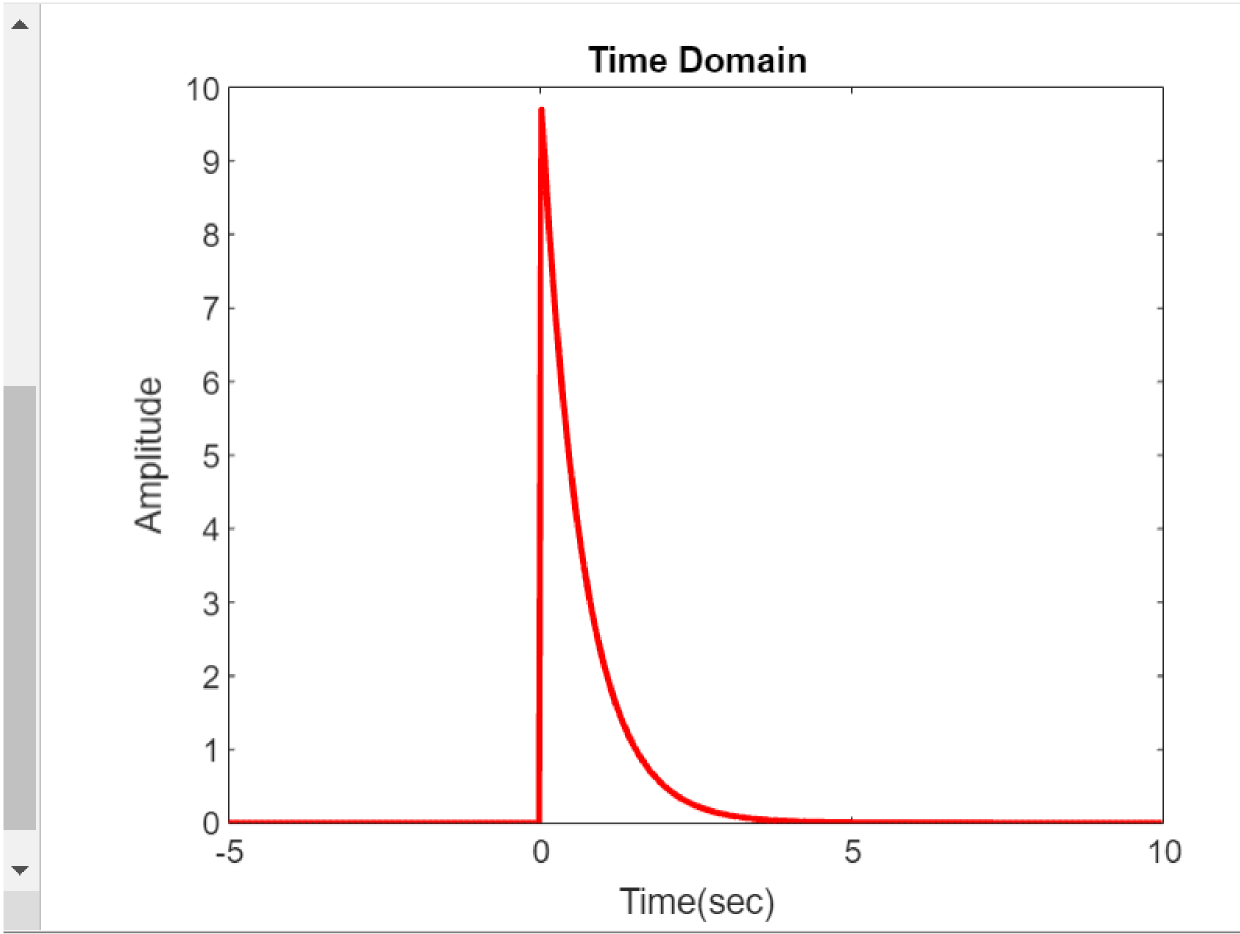
1-$y(t) = (10e^{-(3/2)t})u(t)$

>> Code:

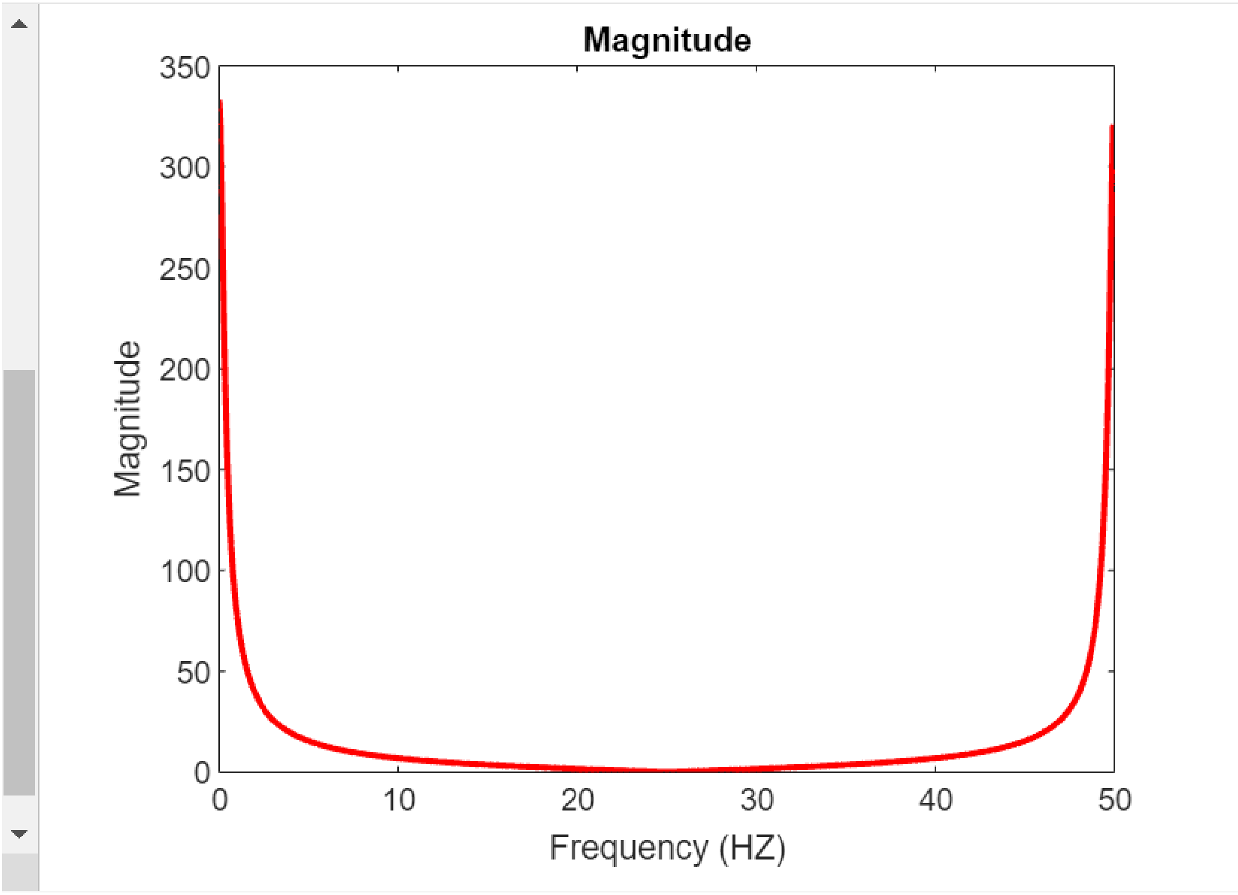
```
clear all
close all
clc
Ts=1/50;
t=-5:Ts:10-Ts;
y=(10*exp(-(3/2)*t).*heaviside(t));
plot(t,y,'r','LineWidth',2);
xlabel('Time(sec)');
ylabel('Amplitude');
title('Time Domain');

y=fft(y);
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
yphase=phasez(y);


```

```
ymag=abs(y);
yphase=phasez(y);


figure
plot(f,ymag,'r','LineWidth',2)
xlabel('Frequency (HZ)')
ylabel('Magnitude')
title('Magnitude')
n=length(y);
fshift=(-n/2:n/2-1)*(fs/n);
yshift=fftshift(y);

figure
plot(fshift,abs(yshift),'r','LineWidth',2);
xlabel('Frequency (HZ)')
ylabel('Phase')
title('Phase spectra')
```

Graph 1:

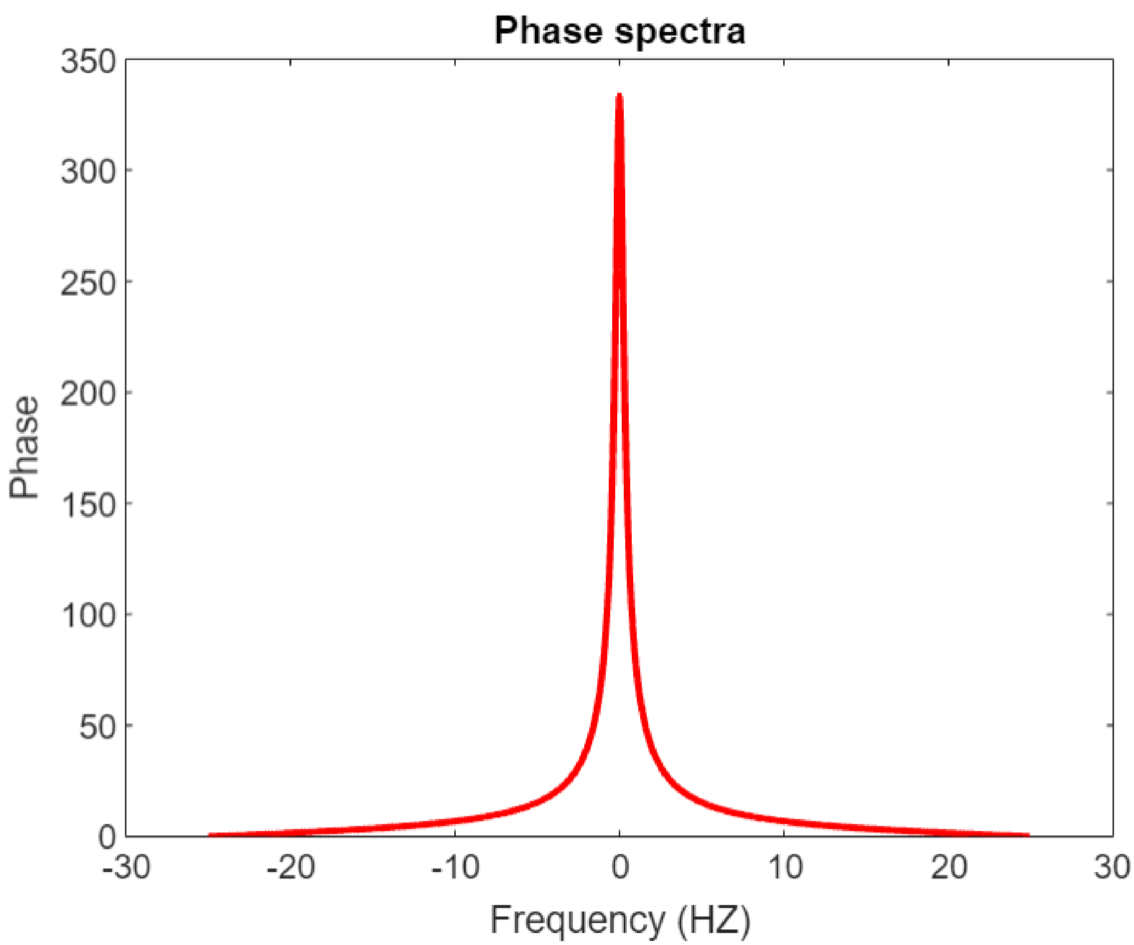


Graph 2:



Magnitude
350
300
250
200
150
100
50
0
Magnitude
0
10
20
30
40
50
Frequency (HZ)

Graph 3:


Phase spectra
350
300
250
200
150
100
50
0
Phase
-30
-20
-10
0
10
20
30
Frequency (HZ)

3- $y(t) = (10e -0.5t \cos 300t)u(t)$

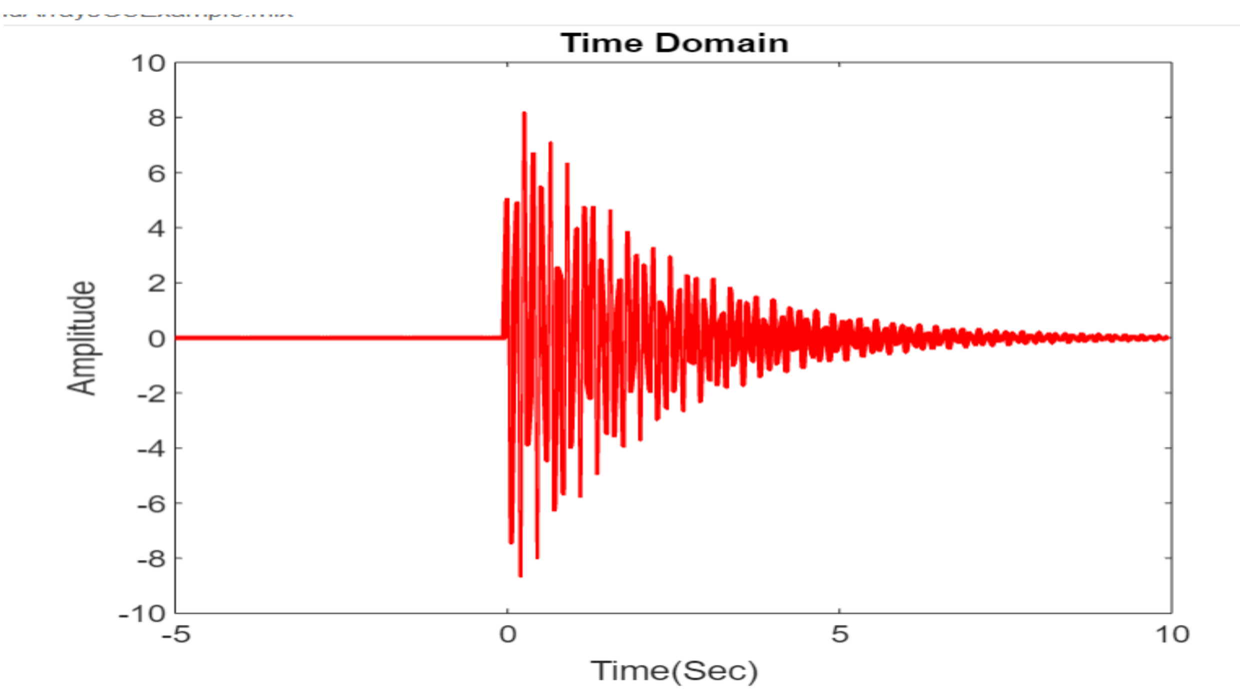
>> Code:

```
clear all
close all
clc
Ts=1/20;
t=-5:Ts:10-Ts;
y=(10*exp((-0.5).*t).*cos(300*t)).*heaviside(t);
plot(t,y,'r','LineWidth',2);
xlabel('Time(Sec)');
ylabel('Amplitude');
title('Time Domain');
y=fft(y);
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
yphase=phasez(y);
figure
n=length(y);
fshift=(-n/2:n/2-1)*(fs/n);
yshift=fftshift(y);
plot(fshift,ymag,'r','LineWidth',2);
xlabel('Frequency(HZ)');
```

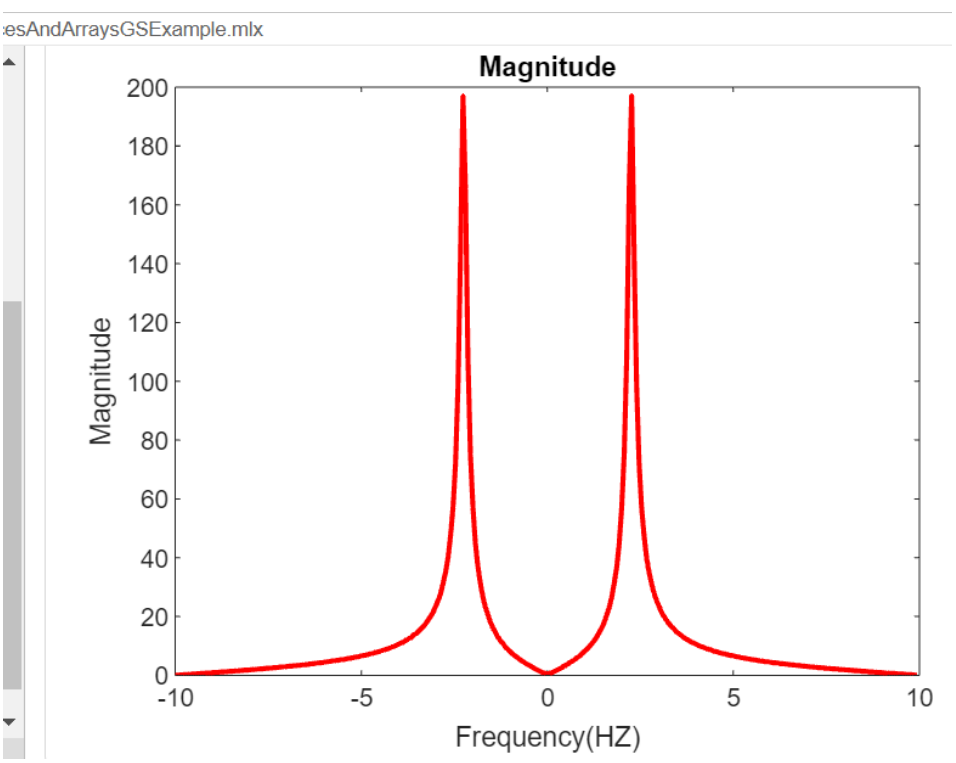

```
title('Time Domain');
y=fft(y);
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
yphase=phasez(y);
figure
n=length(y);
fshift=(-n/2:n/2-1)*(fs/n);
yshift=fftshift(y);
plot(fshift,ymag,'r','LineWidth',2);
xlabel('Frequency(HZ)');
```


```
ylabel('Magnitude');
title('Magnitude');
figure
plot(fshift,abs(yshift),'r','LineWidth',2);
xlabel('Frequency(HZ)');
ylabel('Phase');
title('Phase spectra');
```

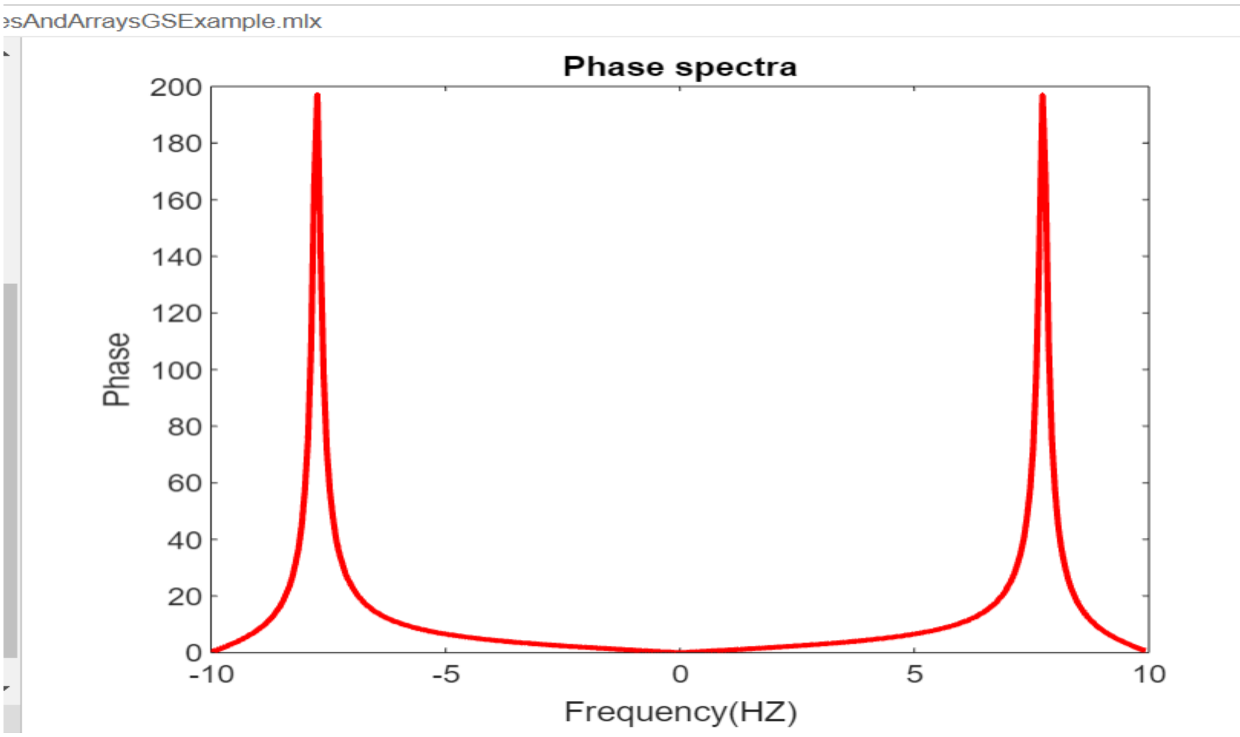
Graph 1:



Graph 2:



Graph 3:


esAndArraysGSExample.mlx
Phase spectra
200
180
160
140
120
100
80
60
40
20
0
Phase
-10
-5
0
5
10
Frequency(HZ)

Question VIII: Write a program that computes the Laplace transform of the function.

3-$y(t) = (15 - 15e^{-0.25t})u(t)$

>> Code:

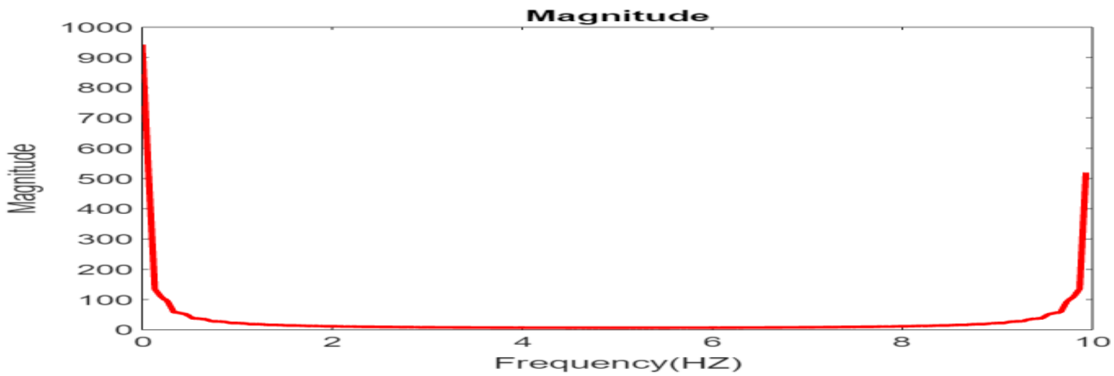
```
clear all
close all
clc
syms t1;
y=(15-15*exp((-0.25).*t1)).*heaviside(t1);
syms f;
yf=fourier(y,f);
syms s;

ys=laplace(y,s)
Ts=1/10;
t=-5:Ts:10-Ts;
y=(15-15*exp((-0.25).*t)).*heaviside(t);
y=fft(y);
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
yphase=phasez(y);

figure
plot(f,ymag,'r','LineWidth',2);
```

/MATLAB Drive/Examples/R2023a/matlab/MatricesAndArraysGSExample/MatricesAndArraysGSExample.mlx

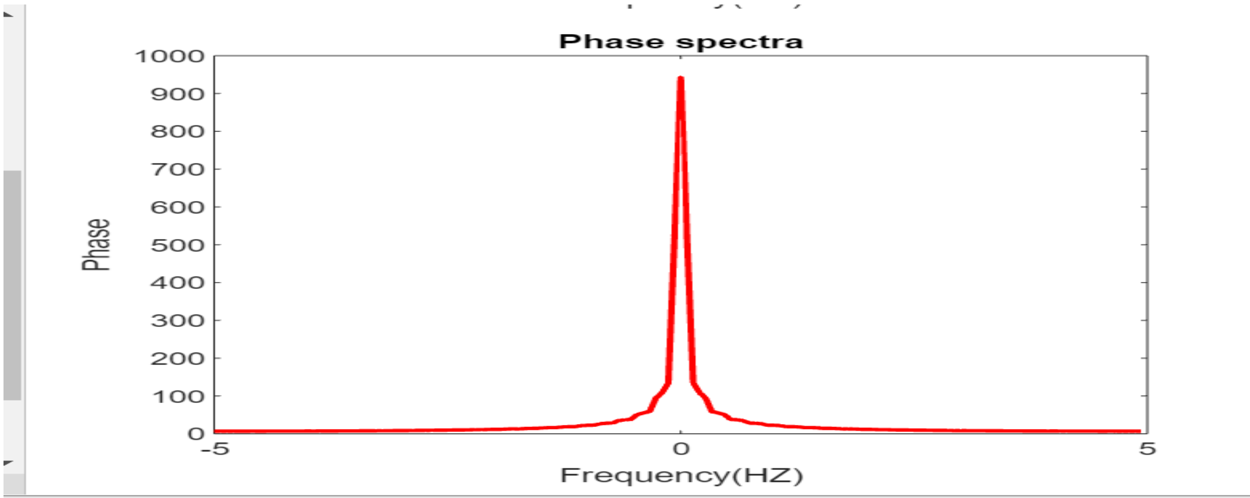

```
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
yphase=phasez(y);

figure
plot(f,ymag,'r','LineWidth',2);
```


```
xlabel('Frequency(HZ)');
ylabel('Magnitude');
title('Magnitude');
n=length(y);
fshift=(-n/2:n/2-1)*(fs/n);
yshift=fftshift(y);

figure
plot(fshift,abs(yshift),'r','LineWidth',2);
xlabel('Frequency(HZ)');
ylabel('Phase');
title('Phase spectra');
```

Graph 1:



Graph 2:



Lablase transform:

ys =

$$\frac{15}{s} - \frac{15}{s + \frac{1}{4}}$$

Fourier transform:

yf =

$$30\,\pi\,\delta(f) - \frac{15}{\frac{1}{4} + f\,\mathrm{i}}$$

4-$y(t) = (20 - 8e^{-3t} \cos 100t)u(t)$

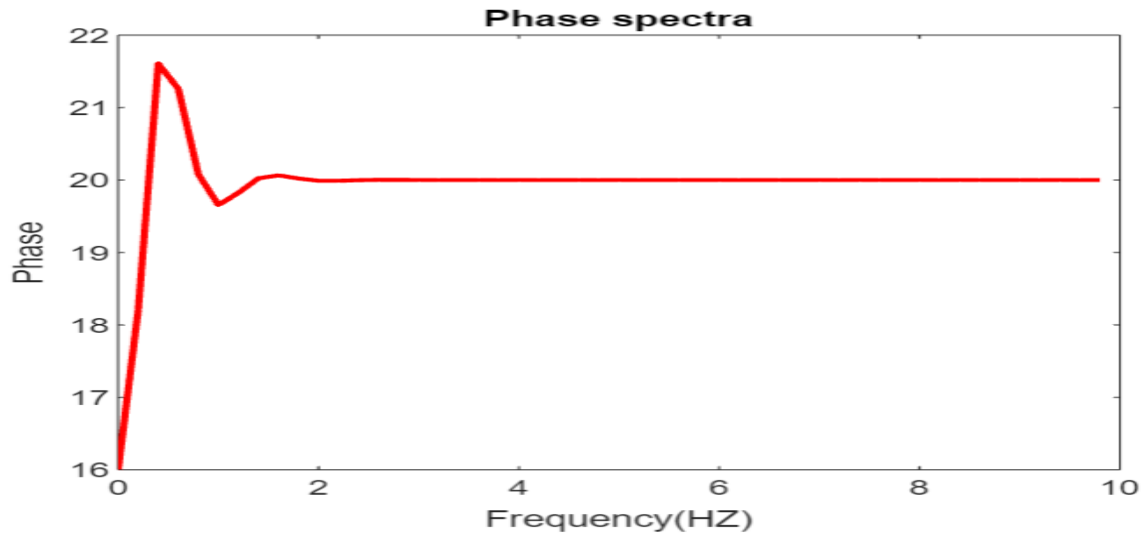
>> Code:

/MATLAB Drive/Examples/R2023a/matlab/MatricesAndArraysGSExample/MatricesAndArraysGSExample.mlx

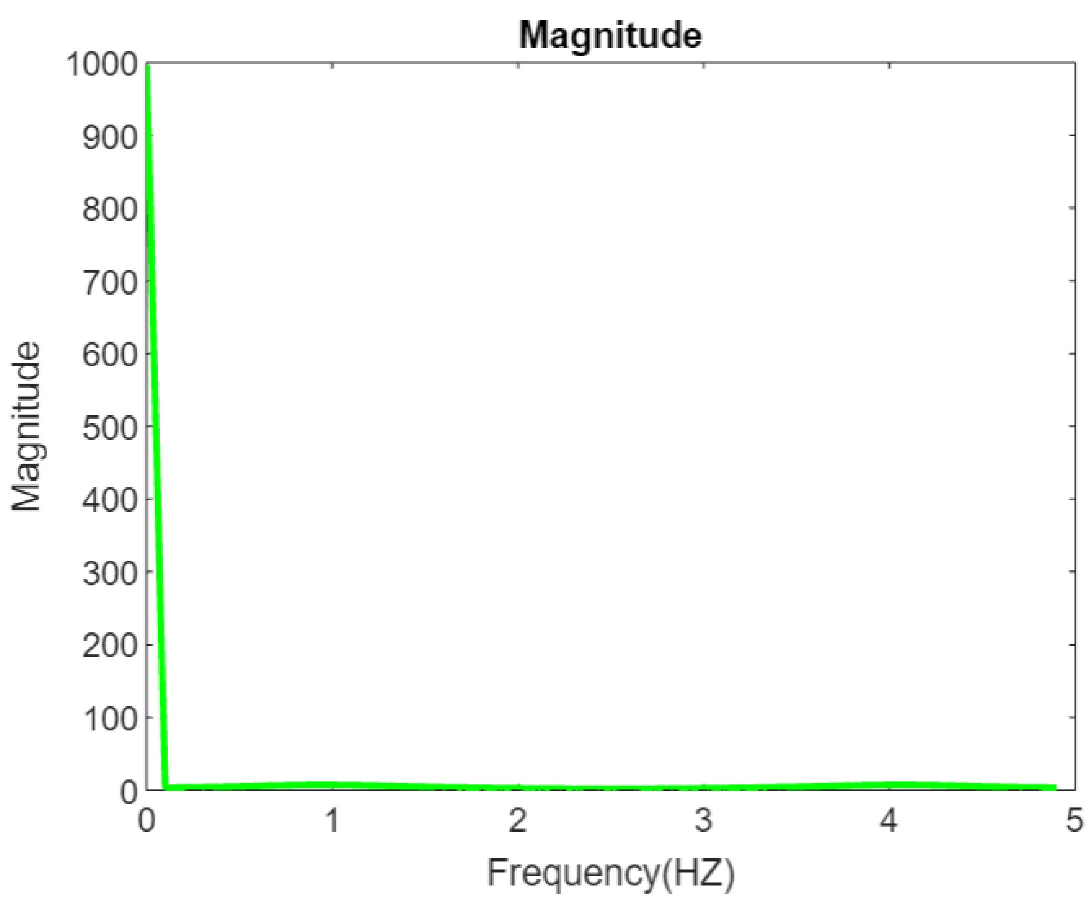
```
syms t1;
y=(20-(8*exp(-3*t1)).*cos(100*t1)).*heaviside(t1);
syms f;
yf=fourier(y,f);

syms s;
ys=laplace(y,s);

Ts=1/5;
t=0:Ts:10-Ts;
y=(20-(8*exp(-3*t).*cos(100*t)).*heaviside(t));
plot(t,y,'r','LineWidth',2);
xlabel('Frequency(HZ)');
ylabel('Phase');
title('Phase spectra')


y=fft(y);
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
```

```
y=fft(y);
fs=1/Ts;
f=(0:length(y)-1)*fs/length(y);
ymag=abs(y);
yphase=phasez(y);


figure
plot(f,ymag,'g','LineWidth',2);
xlabel('Frequency(HZ)');
ylabel('Magnitude');
title('Magnitude');

n=length(y);
fshift=(-n/2:n/2-1)*(fs/n);
yshift=fftshift(y);

figure
plot(fshift,abs(yshift),'r','LineWidth',2);
xlabel('Frequency(HZ)');
ylabel('Magnitude');
title('Magnitude');
```

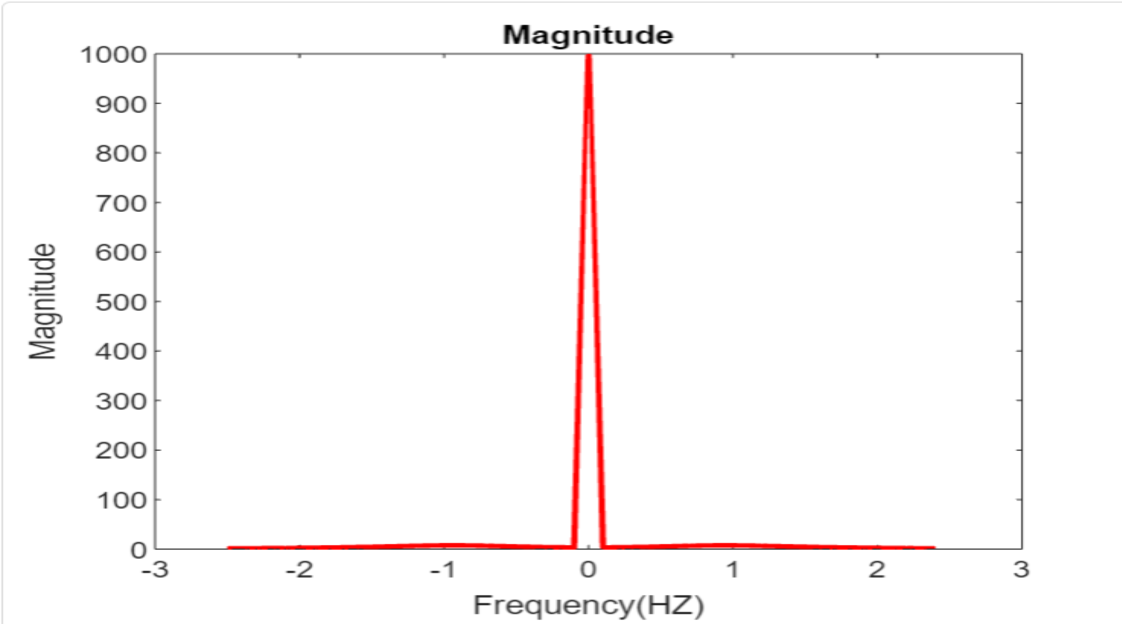
Graph 1:



Graph 2:



Graph 3:



Lablase transform:

ys =

$$\frac{20}{s} - \frac{8\,(s+3)}{(s+3)^2 + 10000}$$

Fourier transform:

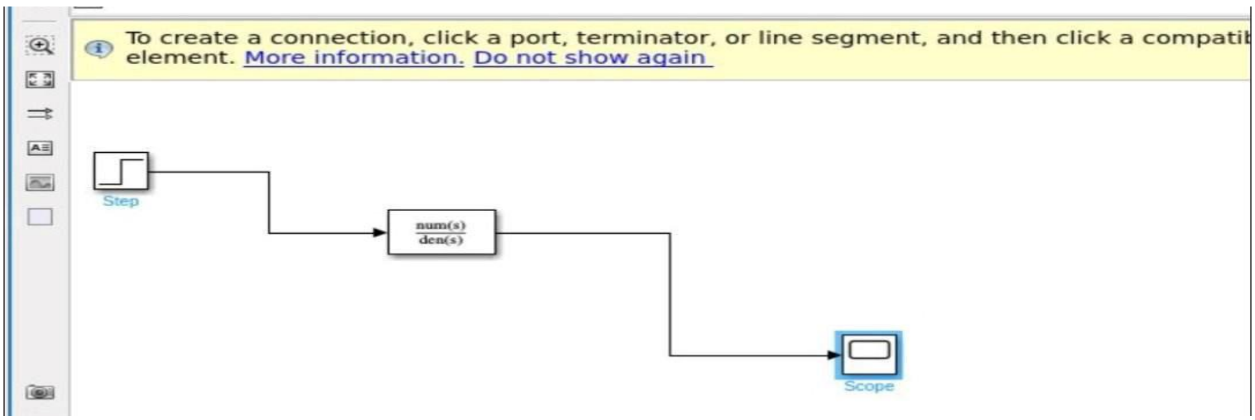
yf =

$$20\,\pi\,\delta(f) - \frac{4}{f\,\mathrm{i} + 3 - 100\,\mathrm{i}} - \frac{4}{f\,\mathrm{i} + 3 + 100\,\mathrm{i}} - \frac{20\,\mathrm{i}}{f}$$

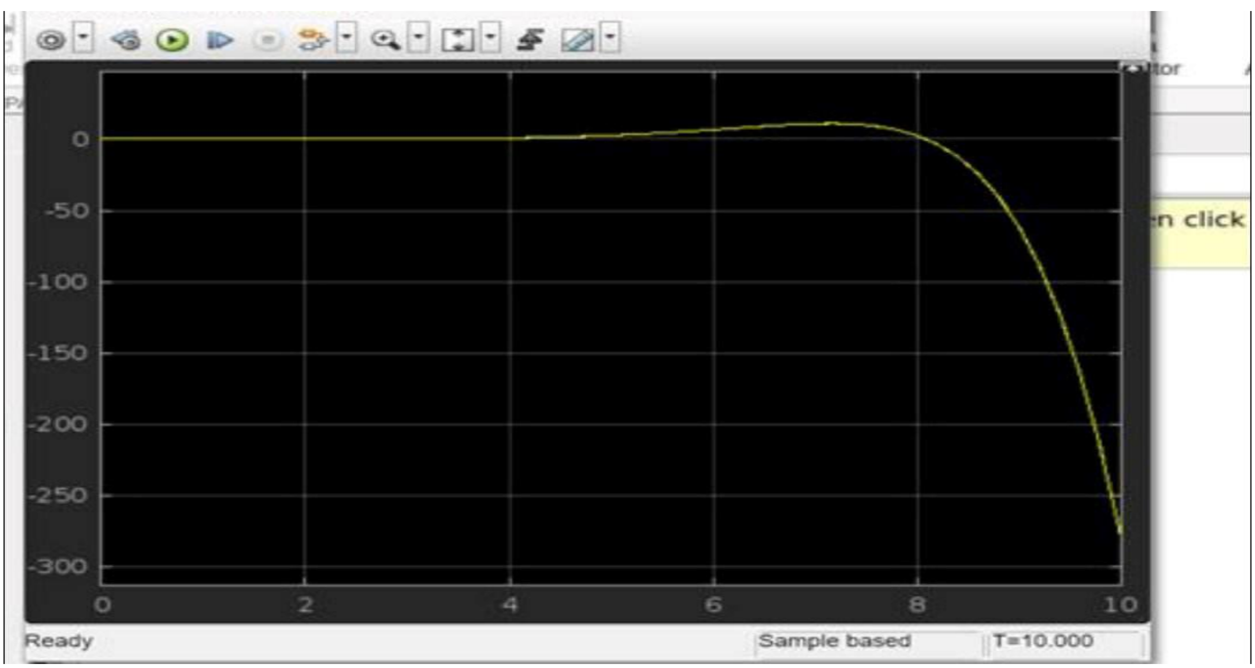
Question IX: Use Simulink (MATLAB) to simulate the following systems in Laplace domain then show and plot the step response of the system.

$6\,d^4 y(t)/dt^4 - 7\,d^2 y(t)/dt^2 + dy/dt + 9y(t) = d^3 x(t)/dt^3 +$

Simulation:



Graph :



Question X: Write a program that determine the inverse Laplace transform of the transfer functions in IV.

>>Code and soluation:

```
syms s t y;
H1=(7/(s+2));
H2=(5/(s^2+(4*s)+5));

h1=ilaplace(H1,s,t);
h2=ilaplace(H2,s,t);

disp('Inverse Laplace Transform of H1:');
disp(h1);

disp('Inverse Laplace Transform of H2:');
disp(h2);
```

```
Inverse Laplace Transform of H1:
```

$7\,e^{-2t}$

```
Inverse Laplace Transform of H2:
```

$5\,e^{-2t}\sin(t)$

Question XII: Consider the transfer function: $H(s)$ = 10000 s + 3/ s 2 + 6s + 8

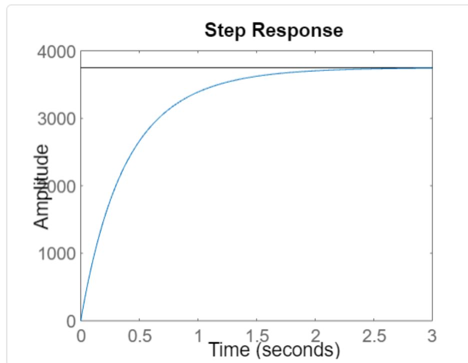
• Compute the step response of the system.

• Plot the frequency response (semi-log scale) of the system with transfer function

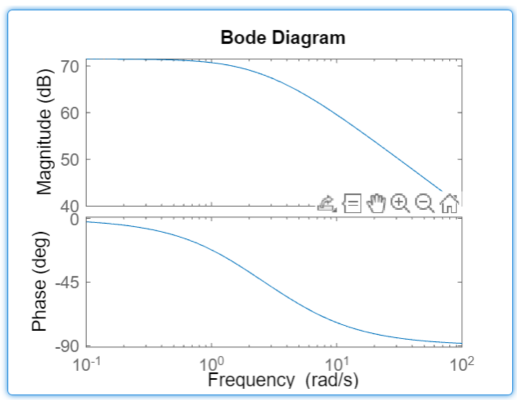
MatricesAndArraysGSExample.mlx *

/MATLAB Drive/Examples/R2023a/matlab/MatricesAndArraysGSExample/MatricesAndArraysGSExample.mlx

```
clear all
close all
clc
num1=[10000 30000];
den1=[1 6 8];
sys=tf(num1,den1);
step(sys);
```




```
clear all
close all
clc
num=[10000 30000];
den=[1 6 8];
bode(num,den);
```



UTF-8 LF script Ln 6 Col 1