Faculty of Engineering and Technology

Electrical and Computer Engineering Department

ENEE2312

SIGNALS AND SYSTEMS

Assignment Report

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Section: 1

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Contents

Q1:

Generate and plot the following signals using MATLAB:

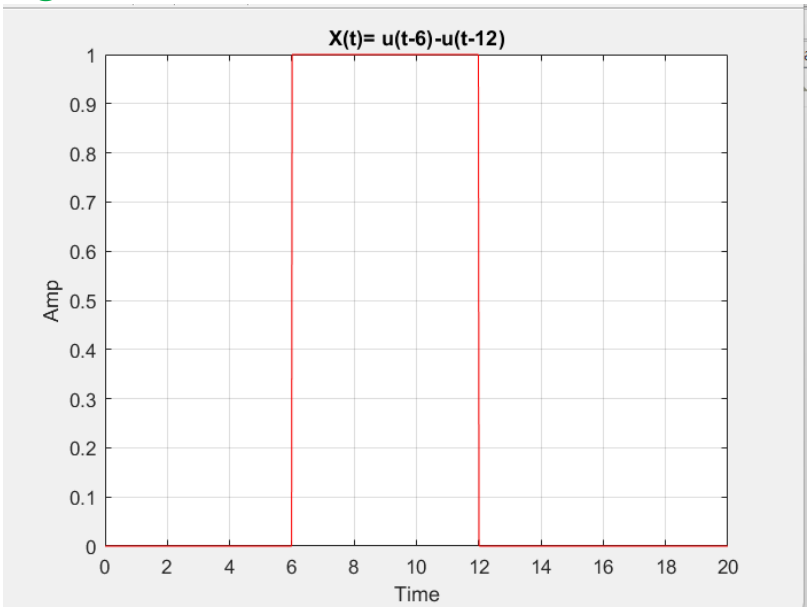
1. $x_1(t) = u(t-6) - u(t-12)$
2. $x_2(t) = u(t-4) + r(t-8) - 2r(t-9) + r(t-13)$ in the time interval = [0, 20]

1)

Code:

```
%TaleenBayatneh_1211305
t=0:0.01:20 ;
X1=heaviside(t-6)-heaviside(t-12);
plot(t,X1,'r');
title('X(t)= u(t-6)-u(t-12)');
xlabel('Time');
ylabel('Amp');
grid on ;
```

Figure:

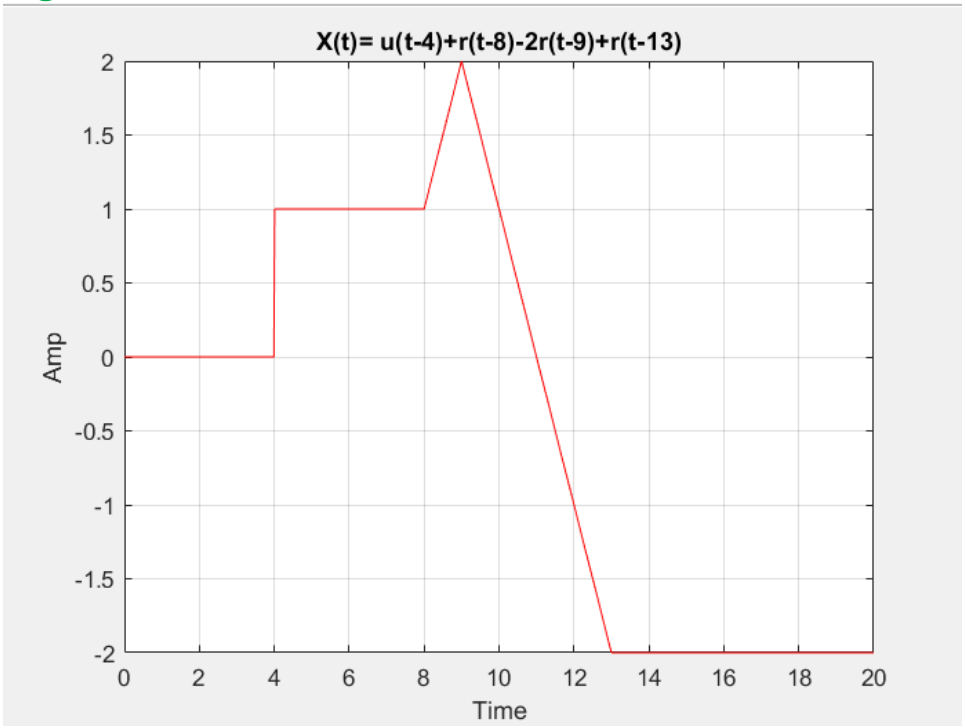


2)

Code:

```
3       %TaleenBayatneh_1211305
4 -     t=0:0.01:20 ;
5 -     u1=heaviside(t-4);
6 -     r1=(t-8).*heaviside(t-8);
7 -     r2=(t-9).*heaviside(t-9);
8 -     r3=(t-13).*heaviside(t-13);
9 -     X2= u1+ r1 - 2.*r2 + r3;
10
11
12 -    plot(t,X2,'r');
13 -    title('X(t)= u(t-4)+r(t-8)-2r(t-9)+r(t-13)');
14 -    xlabel('Time');
15 -    ylabel('Amp');
16 -    grid on ;
```

Figure:



Q2:

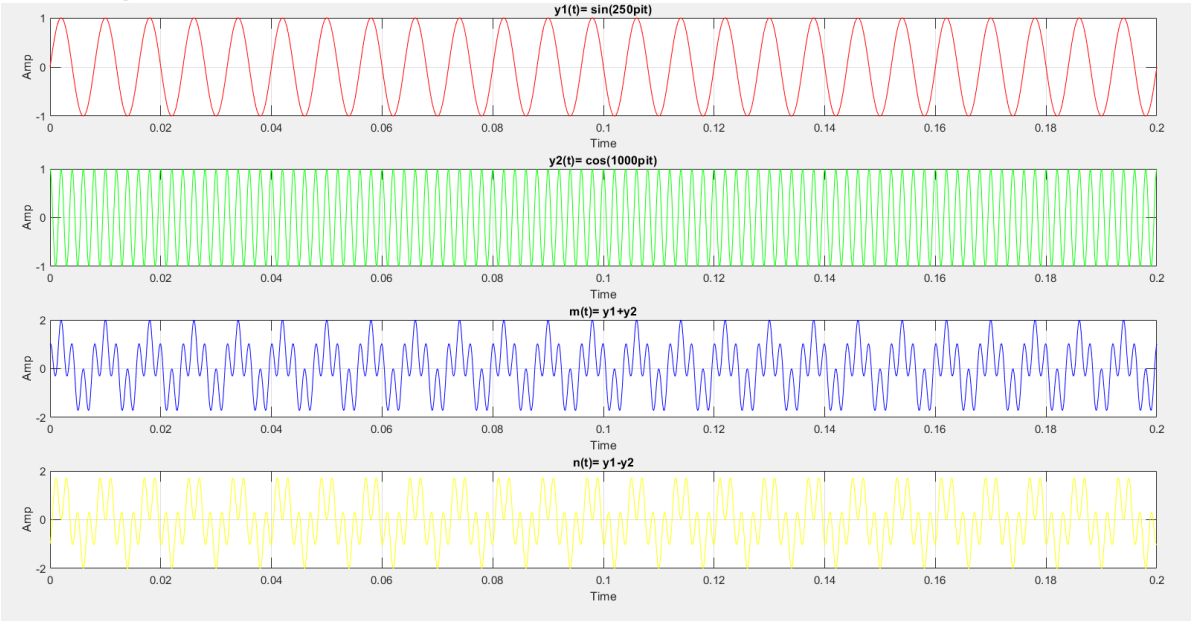
1. Generate and plot the signals $y_1(t)= \sin(250\pi t)$, $y_2(t)= \cos(1000\pi t)$, then plot the signals $m(t)= y_1+y_2$ and $n(t)= y_1-y_2$
2. Determine, using the MATLAB plots, if the sum and/or difference signals are periodic. In case a signal is periodic, determine its fundamental frequency.

1)

Code:

```
t=0:0.0001:0.2 ;
Y1=sin(250*pi*t);
Y2=cos(1000*pi*t);
m=Y1+Y2;
n=Y1-Y2;
subplot(4,1,1)
plot(t,Y1,'r');
title('y1(t)= sin(250pit)');
xlabel('Time');
ylabel('Amp');
grid on ;
subplot(4,1,2)
plot(t,Y2,'g');
title('y2(t)= cos(1000pit)');
xlabel('Time');
ylabel('Amp');
grid on ;
subplot(4,1,3)
plot(t,m,'b');
title('m(t)= y1+y2');
xlabel('Time');
ylabel('Amp');
grid on ;
subplot(4,1,4)
plot(t,n,'y');
title('n(t)= y1-y2');
xlabel('Time');
ylabel('Amp');
grid on ;
```

Figure:



2)

1- y1(t)= sin(250πt)

It is periodic since it is a sinusoidal

Fundamental frequency =125 Hz

2- y2(t)= cos(1000πt)

It is periodic since it is a sinusoidal

Fundamental frequency =500 Hz

3- m(t)= y1+y2 and n(t)= y1−y2

Complex wave pattern , but periodic

Fundamental frequency = 125 Hz

Q3:

Write the MATLAB scripts that solve the following differential equation using zero initial conditions.

$$\frac{d^2}{dt^2}y(t)+2\frac{d}{dt}y(t)+4y(t)=5\cos(1000t)$$

Code:

```
%TaleenBayatneh_1211305
syms Y(t);
dy(t)= diff(Y(t),t);
dy2(t)= diff(Y(t),t,2);
q3_equation =dy2(t)+2*dy(t)+4*Y(t)==5*cos(1000*t);
init1=Y(0)==0;
init2=dy(0)==0;
sol=dsolve(q3_equation,init1,init2)
```

Result:

= sol

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(-
+ (2/1)^3*500)*(250001 - (2/1)^3*500)*4)/t)*cos(3^(1/2)*t))
((250001

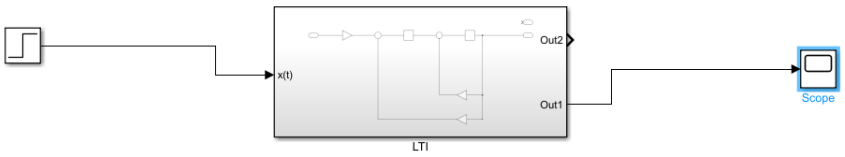
Q4:

Use Simulink (MATLAB) to simulate the following system then show and plot the impulse and step responses of the system.

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

Step response of the system:

Block:



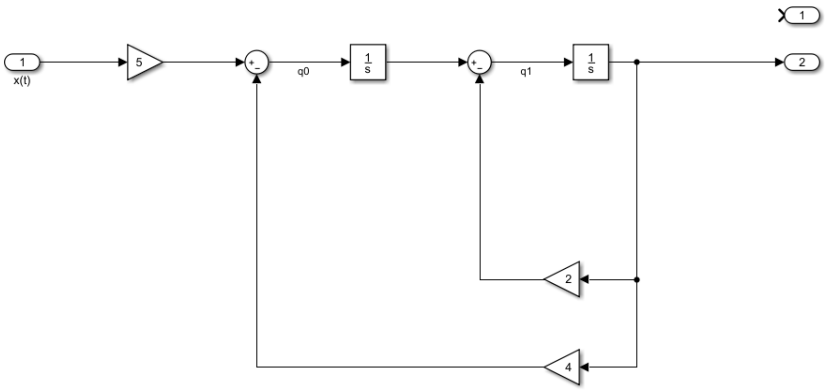
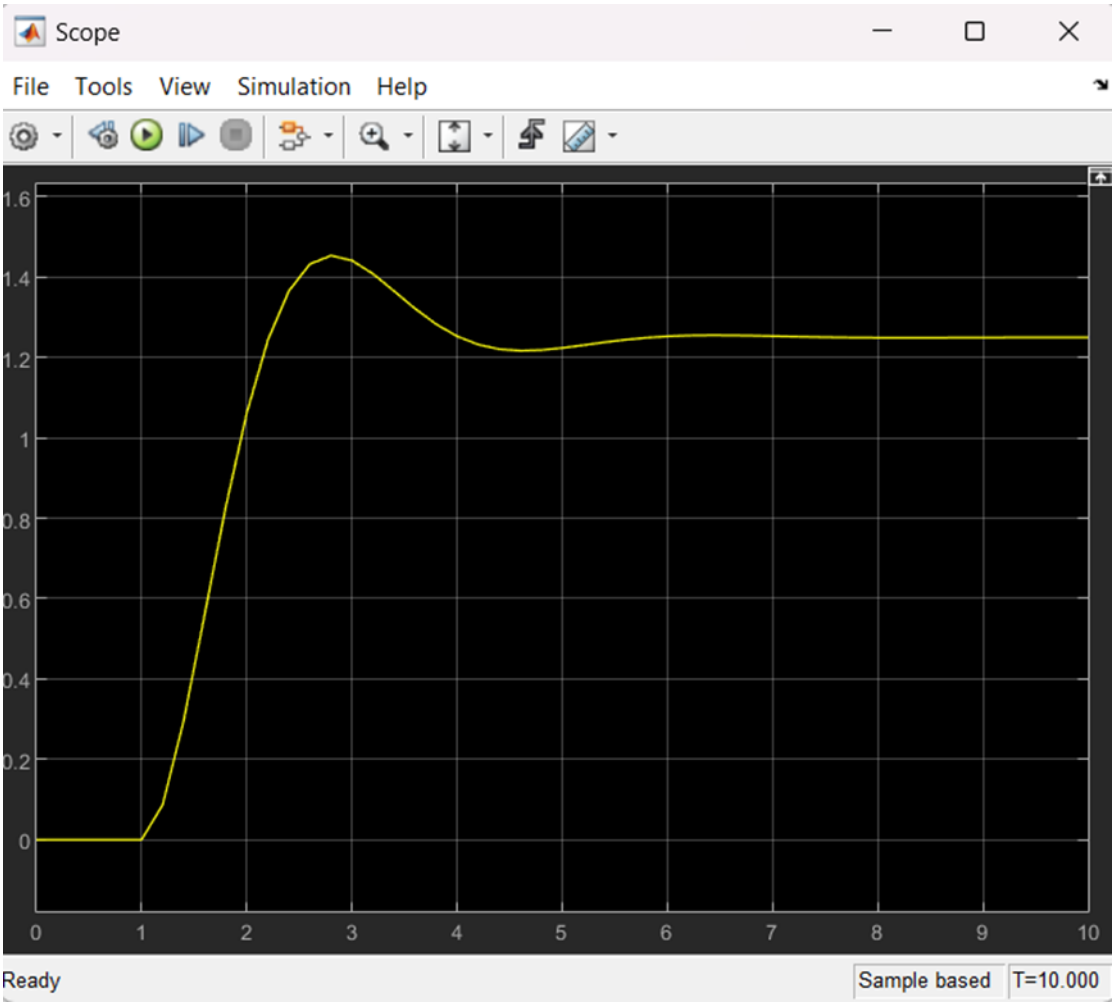


Figure:


Scope
File Tools View Simulation Help
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10
Ready
Sample based
T=10.000

Impulse response of the system:

Block:

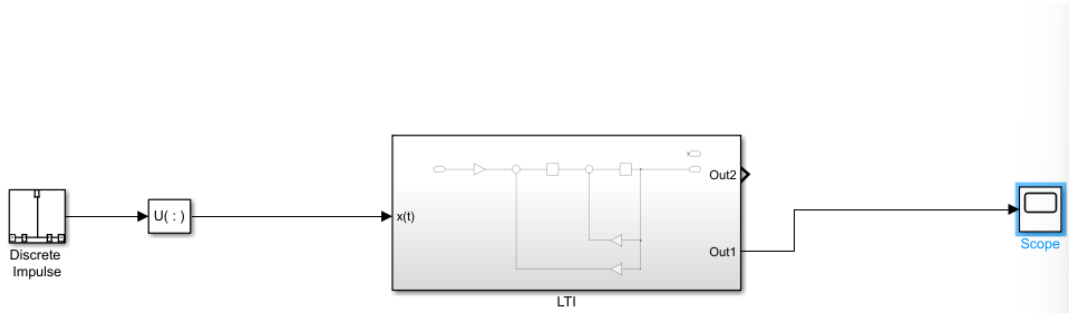
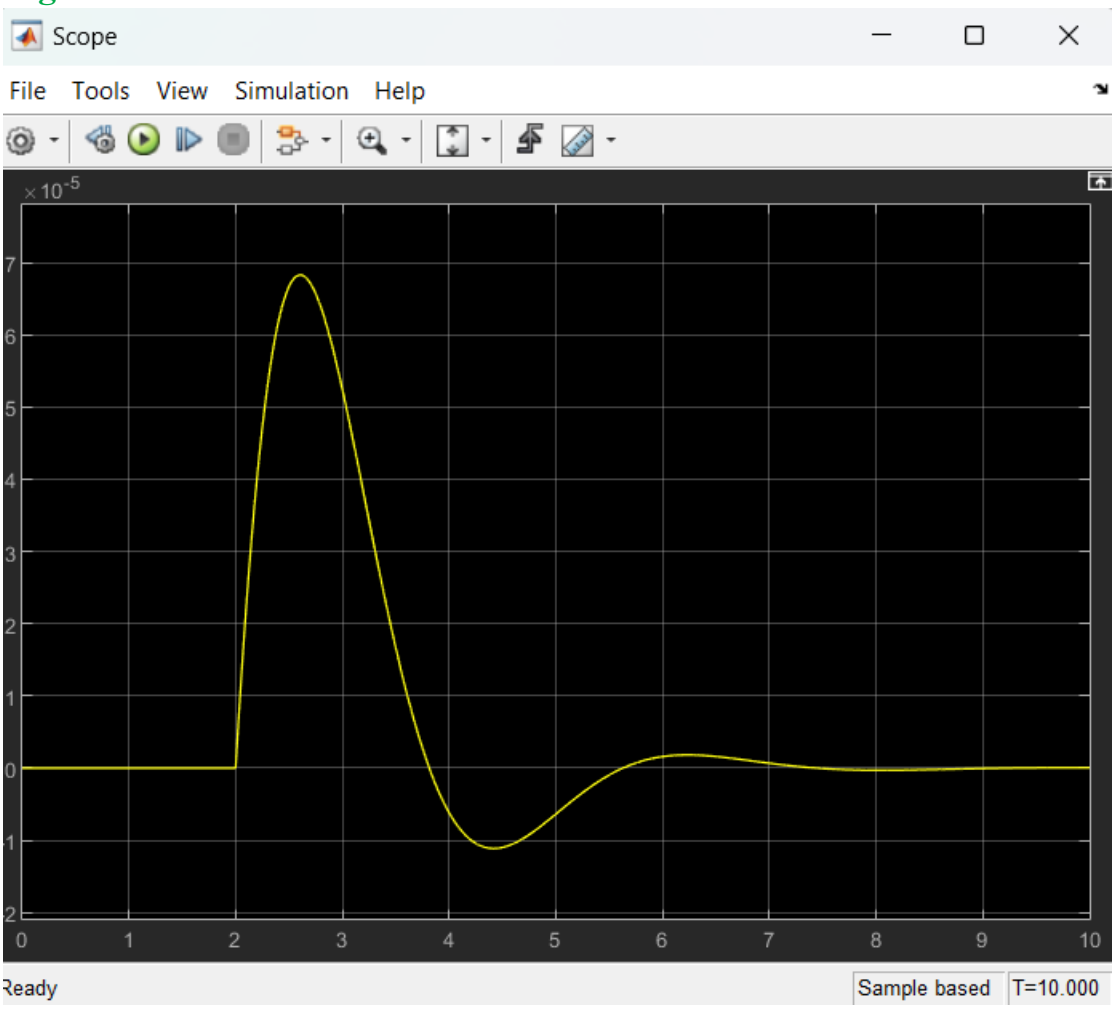


Figure:



Q5:

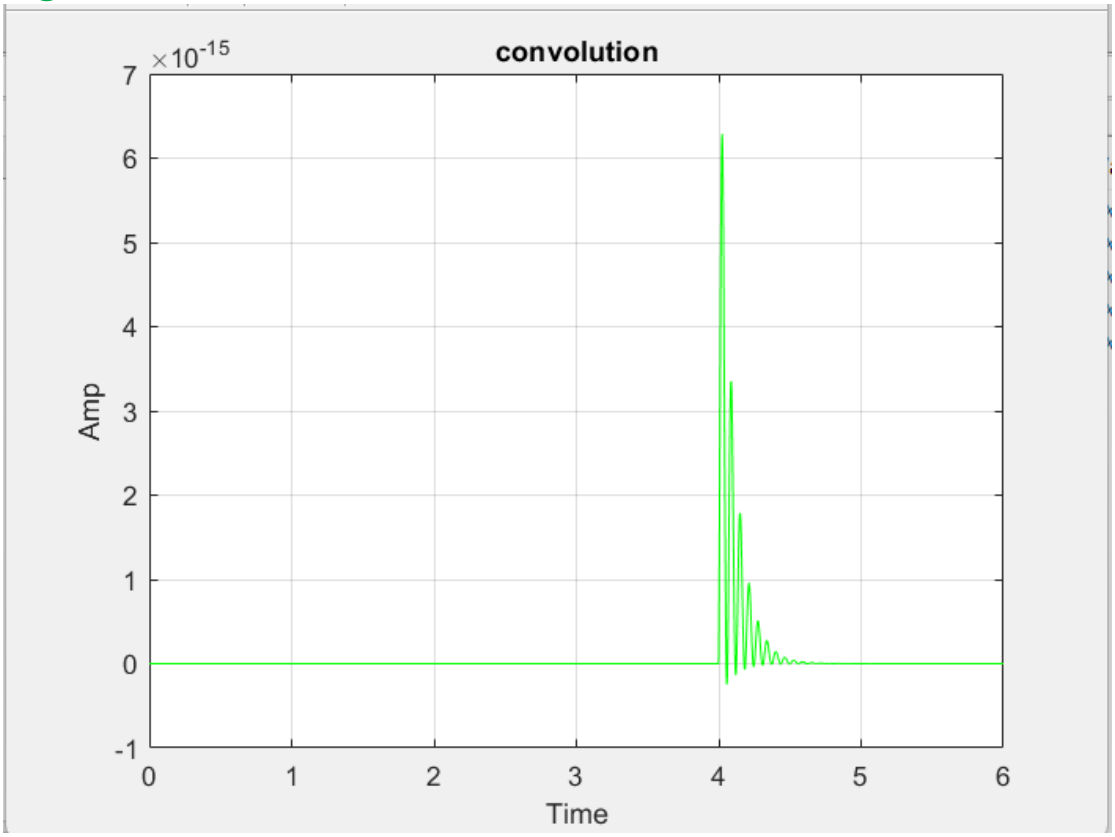
Write a program that computes and plots the convolution ($x_1(t)$*$x_2(t)$) of the functions:

$$x_1(t) = 10e^{-10t}\pi\left(\frac{1}{4}(t-4)\right) \qquad x_2(t) = 10e^{-10t}\cos(100t)\pi\left(\frac{1}{8}(t-6)\right)$$

Code:

```
%TaleenBayatneh_1211305
t=0:0.001:3 ;
x1=(10*exp(-10*t)).*rectpuls((t-4)/4);
x2=((10*exp(-10*t)).*cos(100*t)).*rectpuls((t-6)/8);
convolution = conv(x1,x2);
t2=0:0.001:6 ;
plot(t2,convolution,'g');
title('convolution');
xlabel('Time');
ylabel('Amp');
grid on ;
```

Figure:

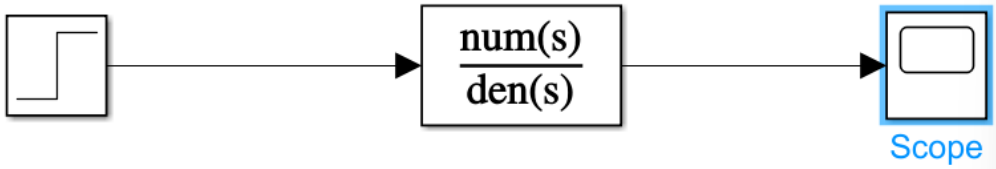


Q6:

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

$$4\frac{d^4}{dt^4}y(t)+7\frac{d^2}{dt^2}y(t)+2\frac{d}{dt}y(t)+3y(t)=7\frac{d^3}{dt^3}x(t)+12x(t)$$

Block:



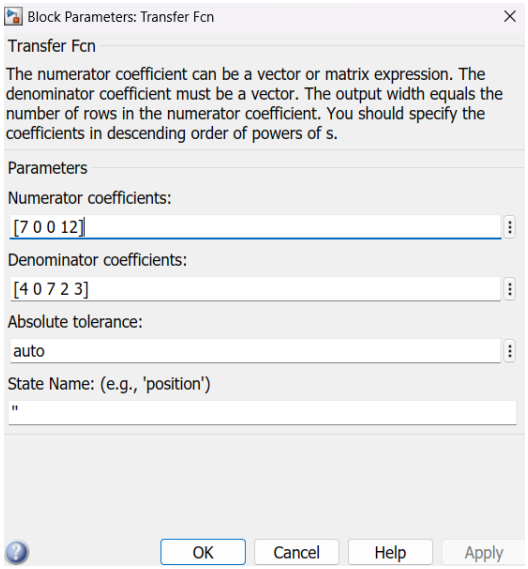
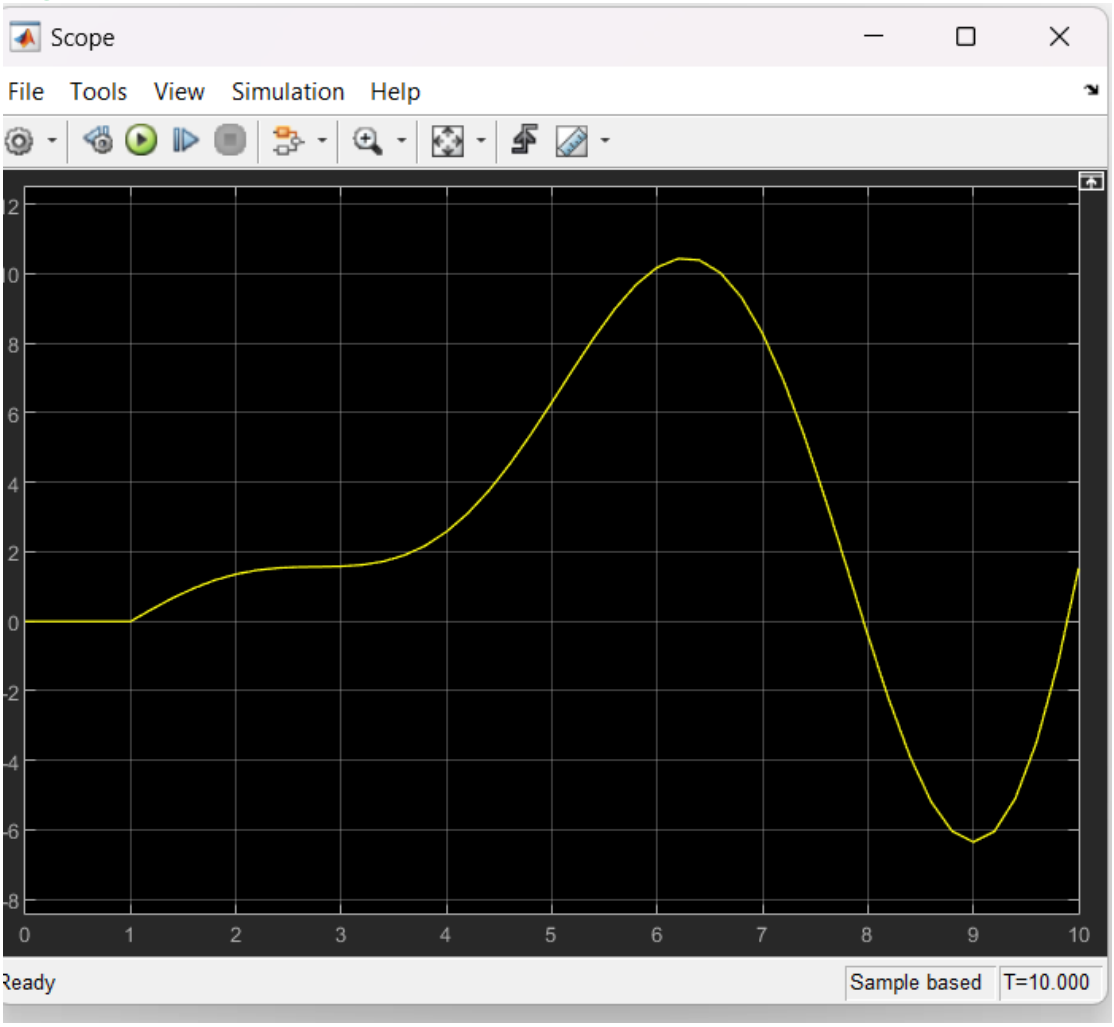


Figure:


Scope
File Tools View Simulation Help
2
0
8
6
4
2
0
-2
-4
-6
-8
0 1 2 3 4 5 6 7 8 9 10
Ready
Sample based
T=10.000

Q7:

Plot the frequency response (semi-log scale) of a system with the following transfer function:

$$H(s) = 10000\frac{s+1}{s^2+4s+2}$$

Code:

```
%TaleenBayatneh_1211305
syms s;
num=[1 1];
den =[1 4 2];
h= 10000 * tf(num,den)
bode(h);
grid on ;
```

Command Window

```
h =

  10000 s + 10000
  ---------------
   s^2 + 4 s + 2

Continuous-time transfer function.
```

Figure: