Faculty of Engineering & Technology
Electrical & Computer Engineering Department

Signal and system EE2312

MATLAB-Assignment

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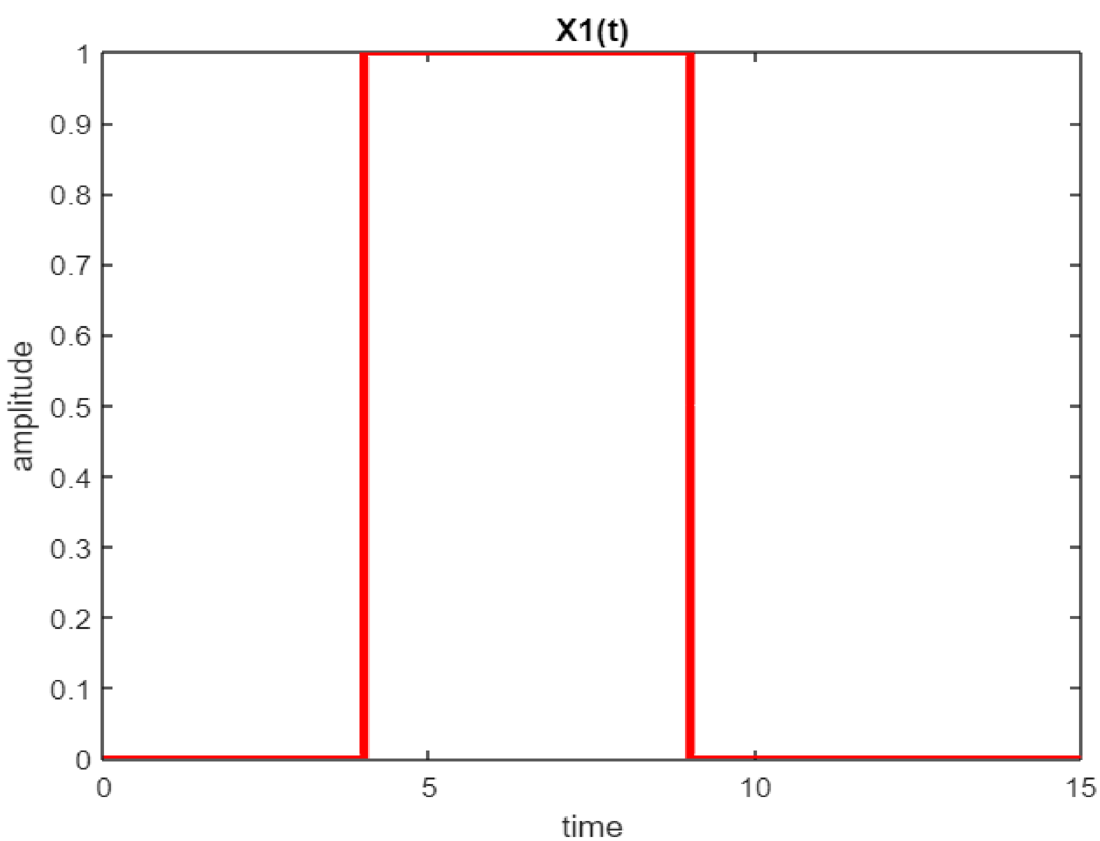
Section:3

Question I:

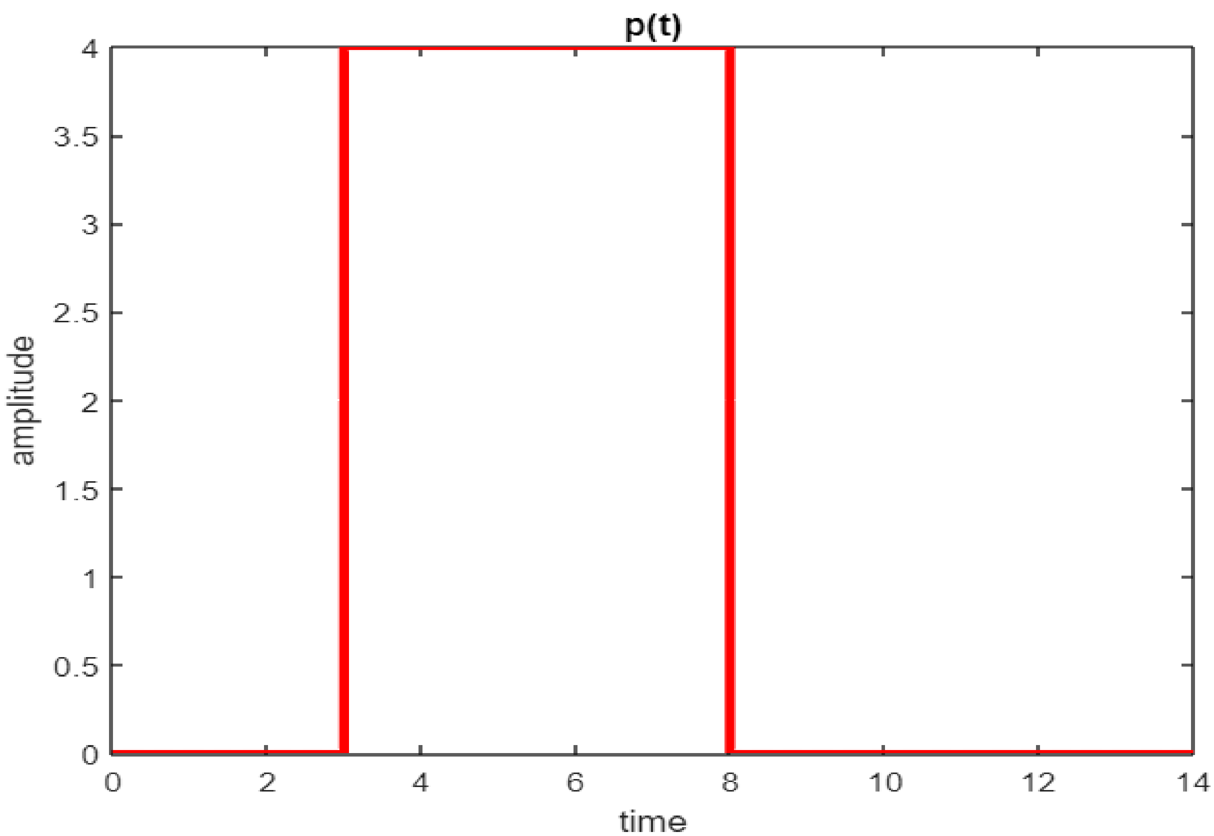
Generate and plot the following signals using MATLAB:

1. $X_1(t) = u(t-4) - u(t-9)$
2. A finite pulse ($\pi(t)$) with value = 4 and extension between 3 and 8
3. $X_2(t) = u(t-4) + r(t-6) - 2r(t-9) + r(t-11)$ in the time interval [0 22]

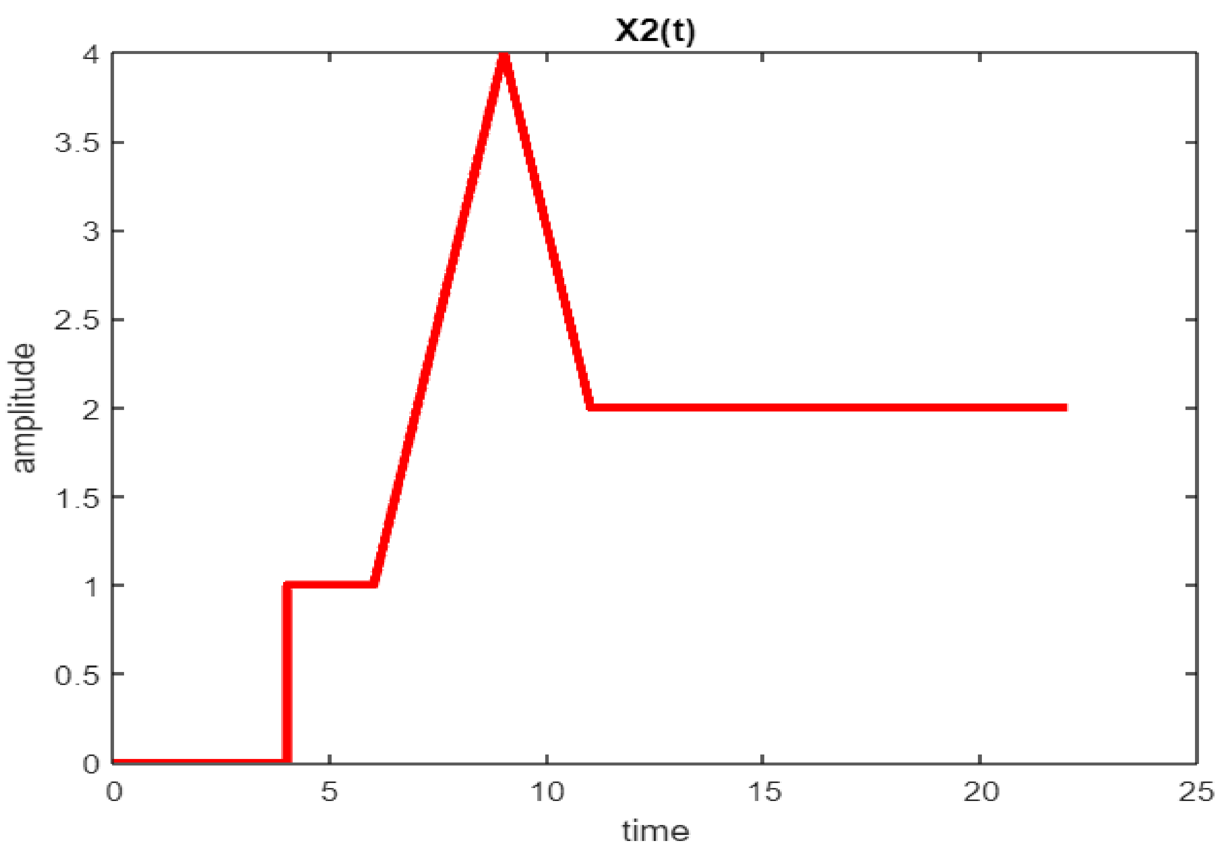
```
t=0:0.001:15;
x1=heaviside(t-4)-heaviside(t-9);
plot(t,x1,'r','LineWidth',3);
title('X1(t)');
xlabel('time');
ylabel('amplitude');
```



```
t=0:0.001:14;
y1= 4 * heaviside(t-3);
y2 = 4* heaviside(t-8);
y = y1-y2;
plot(t,y,'r','LineWidth',3);
title('p(t)');
xlabel('time');
ylabel('amplitude');
```



```
t = 0:0.001:22;
x2= heaviside(t-4) + (t-6).*heaviside(t-6) - 2* (t-9).*heaviside(t-9) + (t-11).*heaviside(t-11);
plot(t,x2,'r','LineWidth',3);
title('X2(t)');
xlabel('time');
ylabel('amplitude');
```

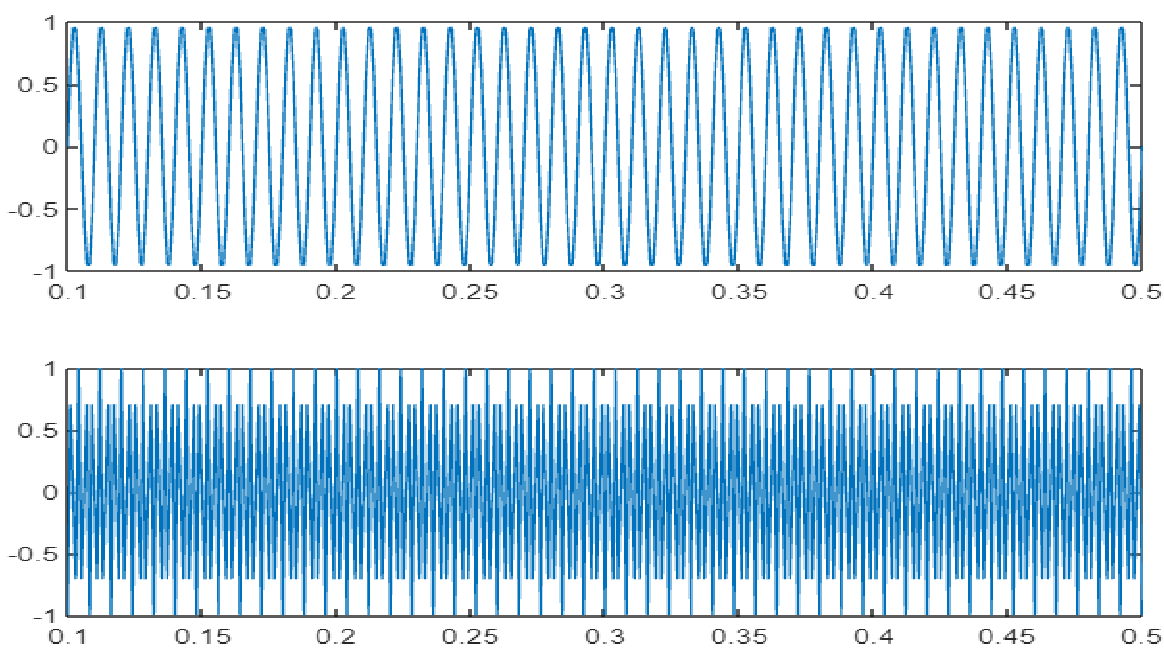


Question II:

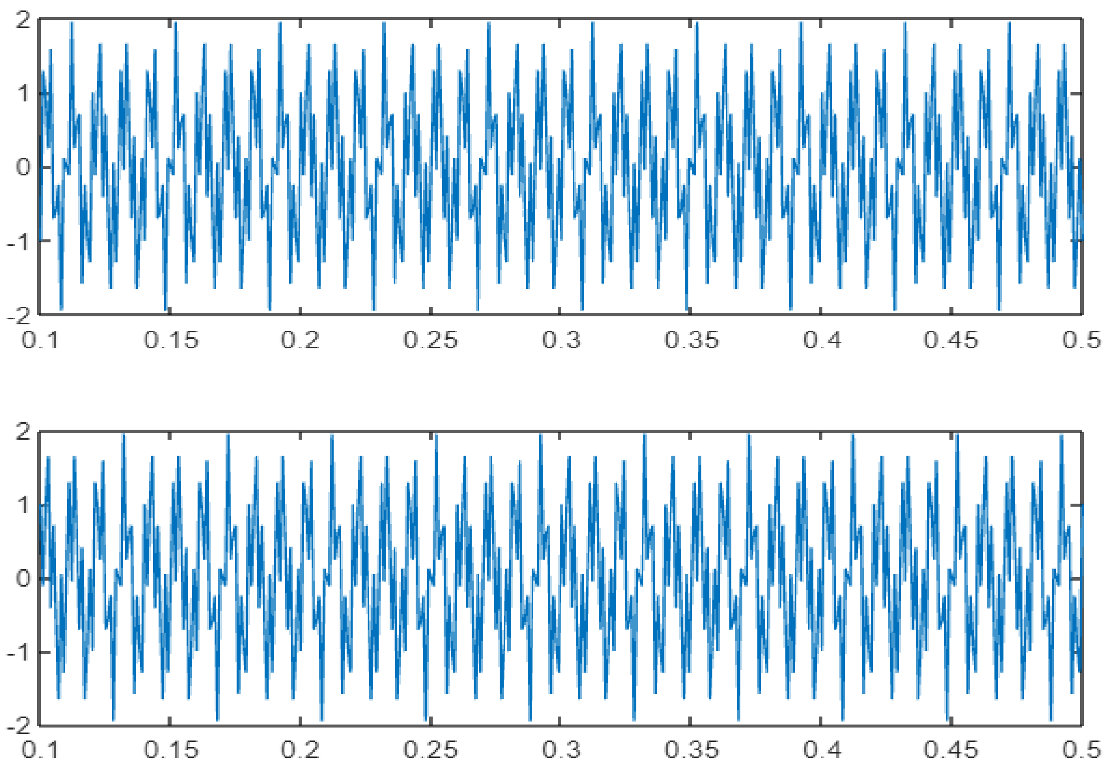
1. Generate and plot the signals $y_1(t)\sin(200\pi t)$, and $y_2(t) = \cos(750\pi t)$, then determine y1 and plot the signals $m(t) = +y2$ and $n(t) = y_1 - y_2$.
2. Determine, using the MATLAB plots, if the sum and/or difference signals are periodic. In case a signal is periodic, determine its fundamental frequency.)

```
t=0.1:0.001:0.5;
y1=sin(200*pi*t);
y2=cos(750*pi*t);
m=y1+y2;
n=y1-y2;

figure
subplot(2,1,1);
plot(t,y1);
subplot(2,1,2);
plot(t,y2);
```



```
figure
subplot(2,1,1);
plot(t,m);
subplot(2,1,2);
plot(t,n);
```



As shown in the matlab all signals are periodic because they repeat themselves periodically.

Question III:

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

1. $10\frac{dy(t)}{dt} + 20y(t) = 10$
2. $\frac{d^2y(t)}{dt^2} + 2\frac{dy}{dt} + 4y(t) = 5\cos 1000t$

```
syms y(t)
dy(t) = diff(y(t),t);
initial_condition = y(0) ==0;
qq = 10 *dy(t)+ 20 *y(t) ==10;
solution = dsolve(qq,initial_condition)
simple_sol = simplify(solution)
```

solution =

$$\frac{1}{2} - \frac{e^{-2t}}{2}$$

simple_sol =

$$\frac{1}{2} - \frac{e^{-2t}}{2}$$

```
syms y(t)
dy(t) = diff(y(t),t);
dy2(t) = diff(y(t),t,2);
condition1 = y(0) ==0;
condition2 = dy(0) == 0;
qq = dy2(t) + 2 * dy(t) + 4 * y(t)== 5*cos(1000*t);
solution = dsolve(qq,condition1,condition2);
simple_sol = simplify(solution)
```

simple_sol =

$$\frac{625\sin(1000\,t)}{62499750001} - \frac{1249995\cos(1000\,t)}{249999000004} + \frac{1249995\,e^{-t}\cos\left(\sqrt{3}\,t\right)}{249999000004} - \frac{1250005\,\sqrt{3}\,e^{-t}\sin\left(\sqrt{3}\,t\right)}{749997000012}$$

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. $\frac{dy(t)}{dt} + 5y(t) = 10u(t)$ $\quad y(0) = 3;$

2. $\frac{d^2y(t)}{dt^2} + 2\frac{dy}{dt} + 2y(t) = 5\cos 2500t$ $\quad (y(0) = 1,\ y'(0) = 2);$

```
clear all
close all
clc
syms y(t)
D1=diff(y,t);
fun=(D1+(5.*y))==10.*heaviside(t);
condition1=y(0)==3;
condition=[condition1];
solution = dsolve(fun,condition)
```

solution = $2\,e^{-5t} - e^{-5t}\,(\mathrm{sign}(t) - e^{5t}\,(\mathrm{sign}(t) + 1))$

```
simple_sol=simplify(solution)
```

simple_sol = $2\,e^{-5t} + \mathrm{sign}(t) - e^{-5t}\,\mathrm{sign}(t) + 1$

```
clear all
close all
clc
syms y(t)
D1=diff(y,t);
D2=diff(y,t,2);
fun=(D2+(2.*D1)+(2.*y))==5.*cos(2500.*t);
con1=y(0)==1;
con2=D1(0)==2;
cond=[con1,con2];
solution =dsolve(fun,cond)
```

Solution

solution =

sin(t)*((5*cos(2499*t))/12490004 + (5*cos(2501*t))/12510004 + (12495*sin(2499*t))/12490004 + (12505*sin(2501*t))/12510004) - cos(t)*((12495*cos(2499*t))/12490004 - (12505*cos(2501*t))/12510004 - (5*sin(2499*t))/12490004 + (5*sin(2501*t))/12510004) + (19531265624997*exp(-t)*cos(t))/19531250000002 + (58593734375001*exp(-t)*sin(t))/19531250000002

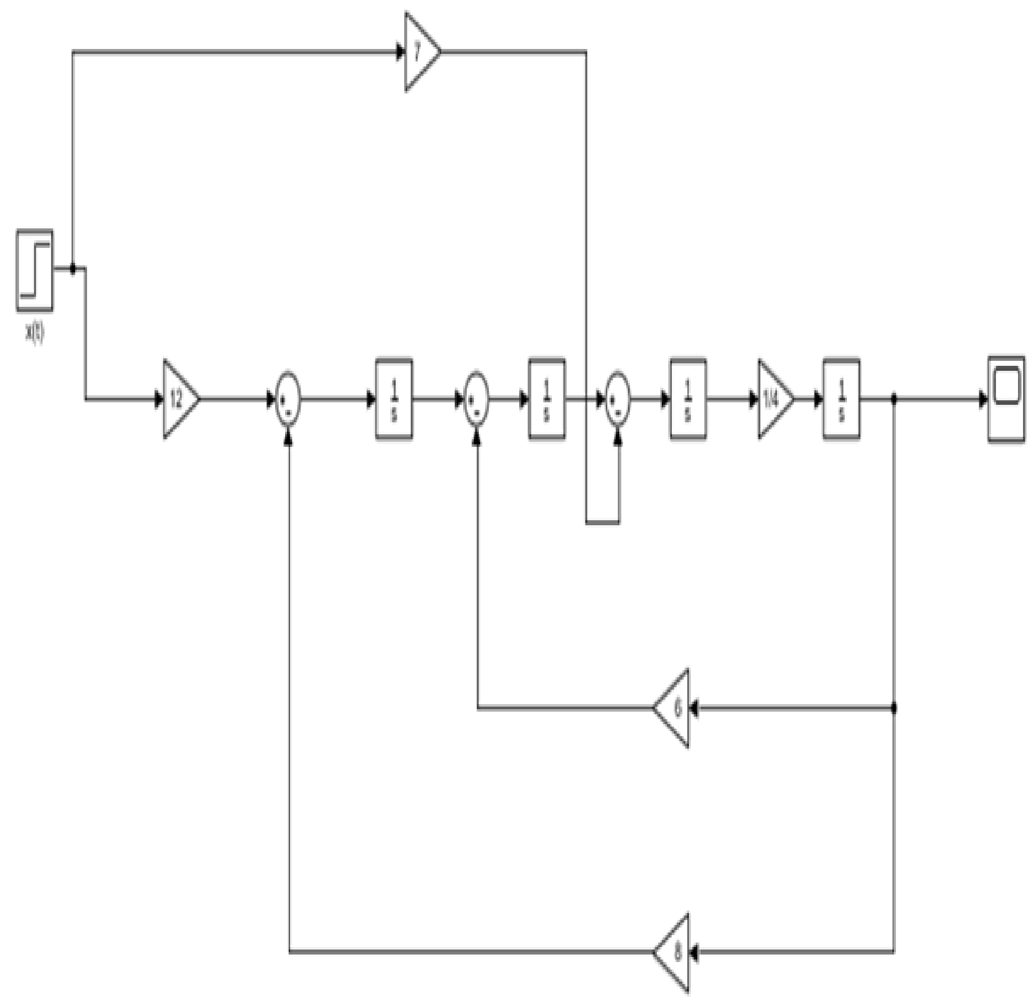
simple_sol =

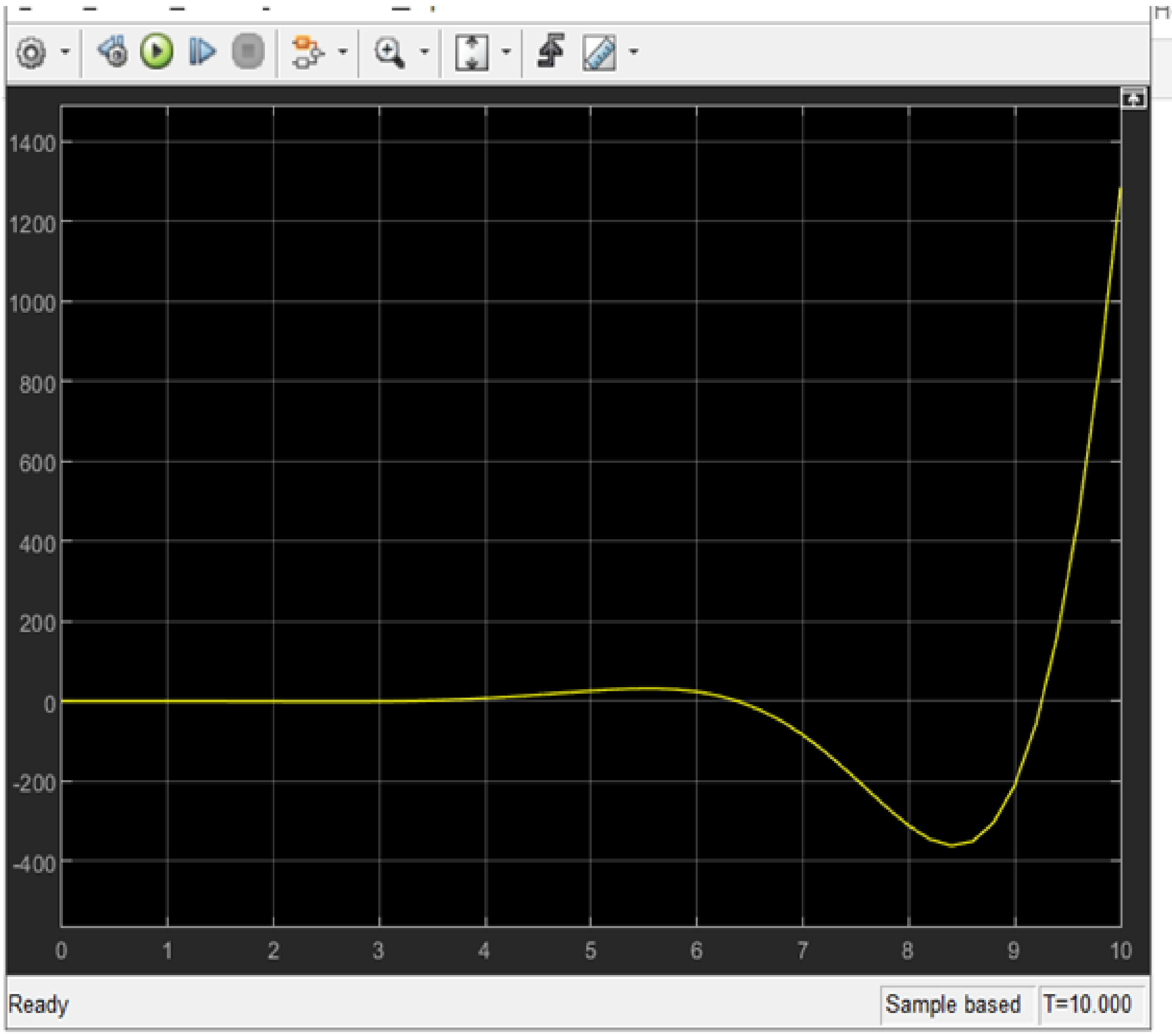
sin(t)*((5*cos(2499*t))/12490004 + (5*cos(2501*t))/12510004 + (12495*sin(2499*t))/12490004 + (12505*sin(2501*t))/12510004) - cos(t)*((12495*cos(2499*t))/12490004 - (12505*cos(2501*t))/12510004 - (5*sin(2499*t))/12490004 + (5*sin(2501*t))/12510004) + (19531265624997*exp(-t)*cos(t))/19531250000002 + (58593734375001*exp(-t)*sin(t))/19531250000002

Question V:

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

1. $4\frac{d^4y(t)}{dt^4}+6\frac{dy(t)}{dt}+8y(t)=7\frac{d^2x(t)}{dt^2}+12x(t)$
2. $H(s)=\frac{100(s+3)}{(s+1)*(s+4)}+\frac{10}{(s+10)}$ (Hint: transform to differential equation form)




1400
1200
1000
800
600
400
200
0
-200
-400
0
1
2
3
4
5
6
7
8
9
10
Ready
Sample based
T=10.000

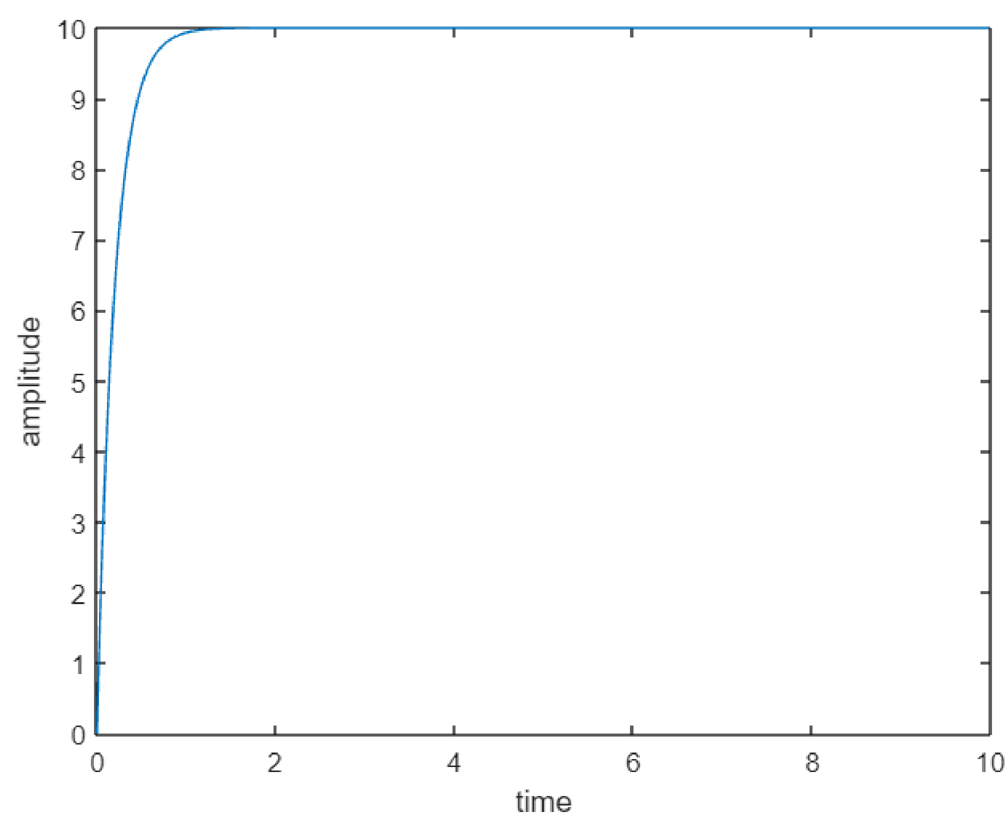
Question VI:

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

1. $y(t) = (10e^{-10t})$u(t)
2. $y(t) = (10e^{-10t}\cos 100t)$u(t)

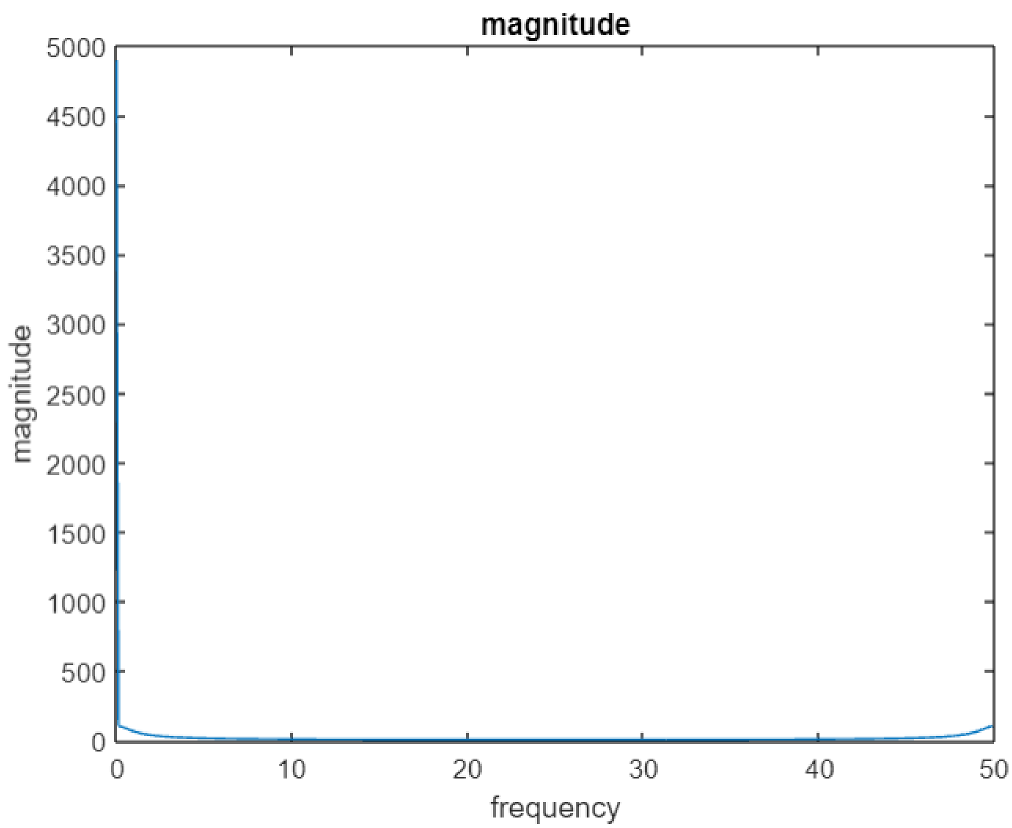
1-

```
close all
Ts= 1/50;
t= 0: Ts:10-Ts;
x=(10 - 10.*exp(-5.*t)).*(heaviside(t));
plot(t,x);
xlabel('time');
ylabel('amplitude');
```



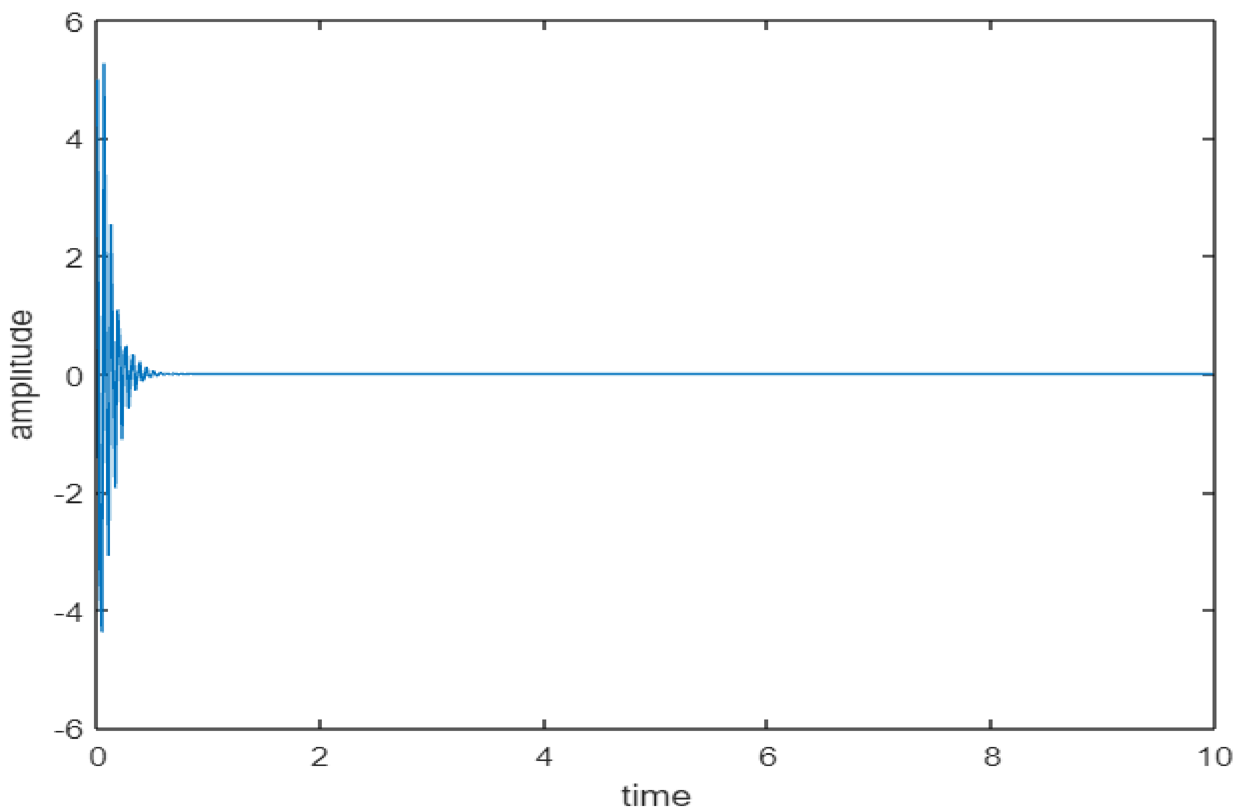
```
y=fft(x);
fs = 1/Ts;
f = (0:length(y)-1)*fs/length(y);
ymag = abs(y);

figure
plot(f,ymag)
xlabel('frequency');
ylabel('magnitude');
title('magnitude');
```



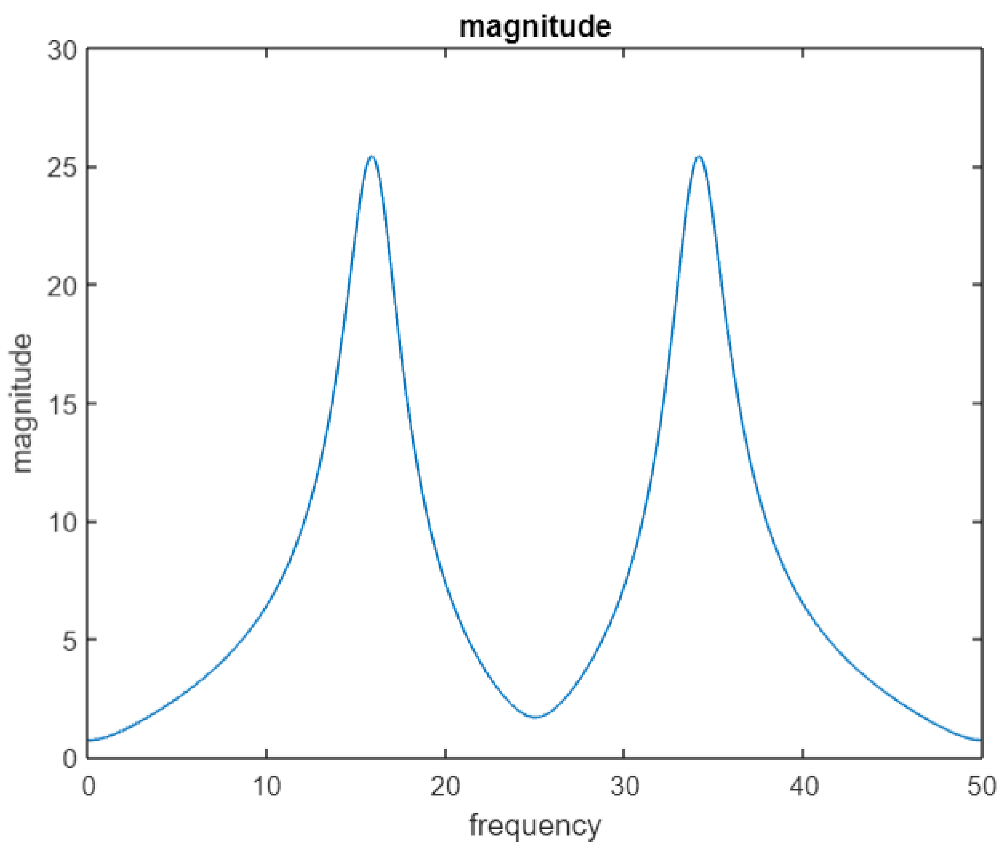
2-

```
close all
Ts= 1/50;
t= 0: Ts:10-Ts;
x=(10.*exp(-10.*t).*cos(100.*t)).*heaviside(t);
plot(t,x);
xlabel('time');
ylabel('amplitude');
```



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

figure
plot(f,ymag)
xlabel('frequency');
ylabel('magnitude');
title('magnitude');
```



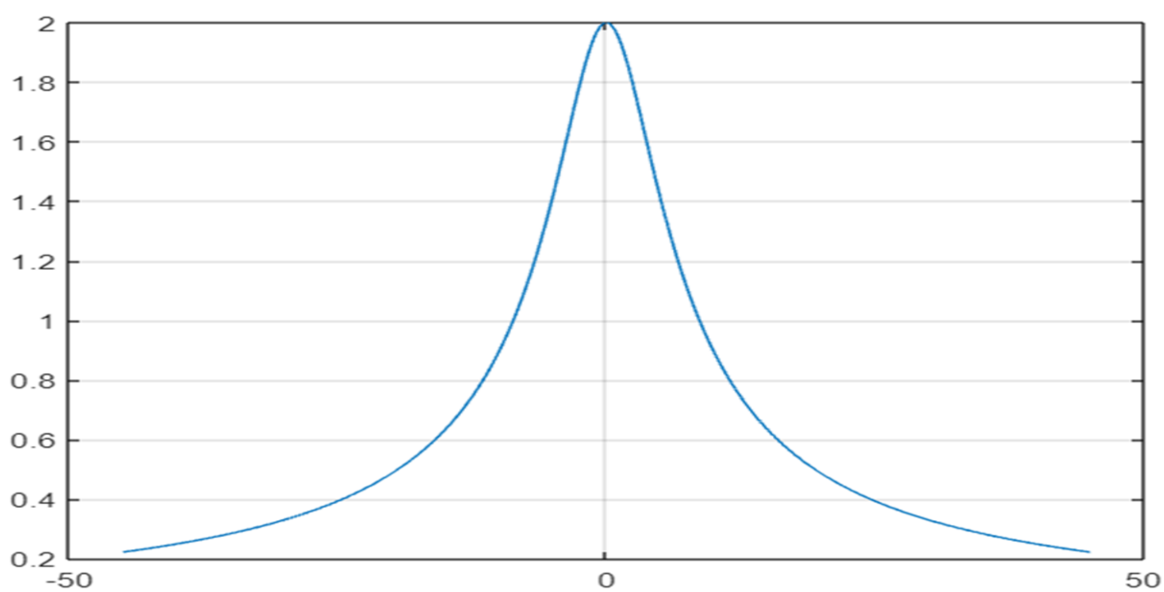
Question VII:

Write a program that computes the Laplace and Fourier transforms of the function and plot the phase and amplitude spectra.

3. $y(t) = (10 - 10e^{-5t})u(t)$
4. $y(t) = (30 - 10e^{-8t}\cos 100t)u(t)$

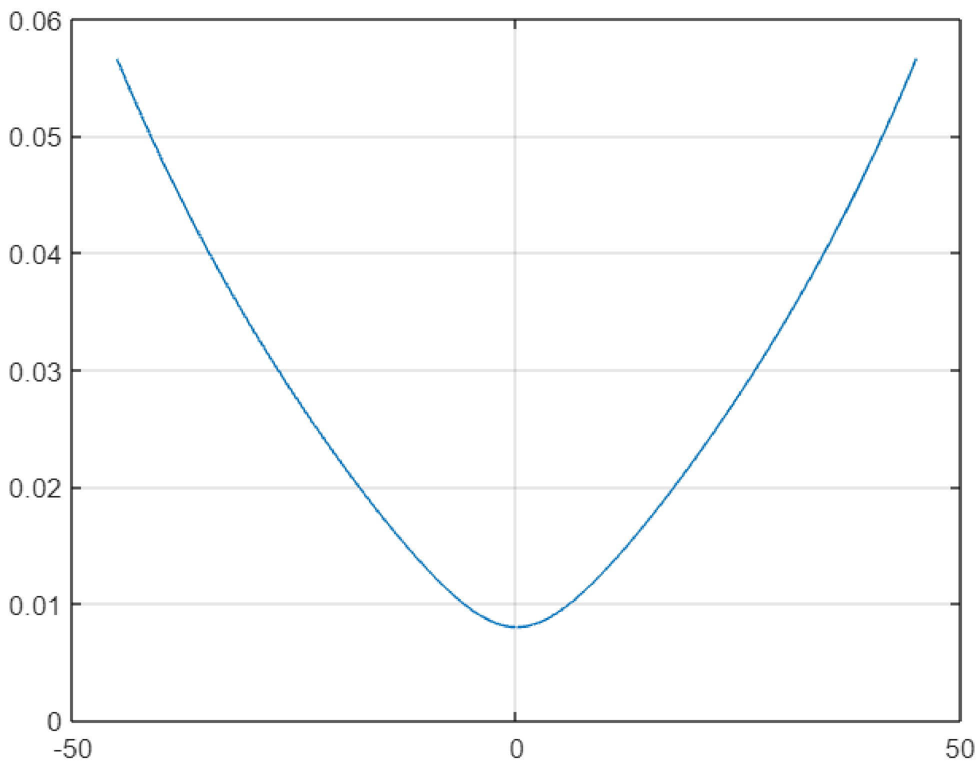
1-

```
syms t;
f=10-10*exp(-5*t)*heaviside(t);
F=fourier(f);
fmagnitude=abs(F);
phase = angle(F);
l=laplace(f);
w=-45:0.1:45;
figure
plot(w,subs(fmagnitude,w));
grid on
```

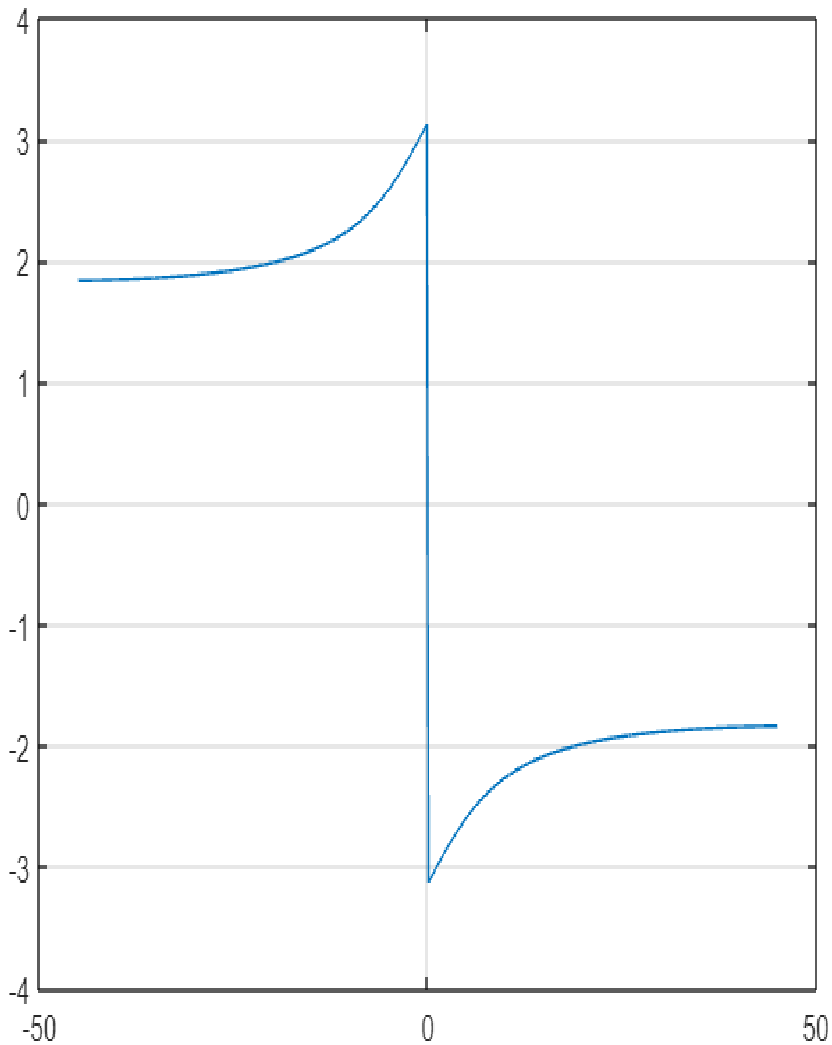


2-

```
syms t;
f=30-10*exp(-8*t)*cos(100*t)*heaviside(t);
F=fourier(f);
fmagnitude=abs(F);
phase = angle(F);
lap=laplace(f);
w=-45:0.1:45;
figure
plot(w,subs(fmagnitude,w));
grid on
```



```
figure
plot(w,subs(phase,w));
grid on
```



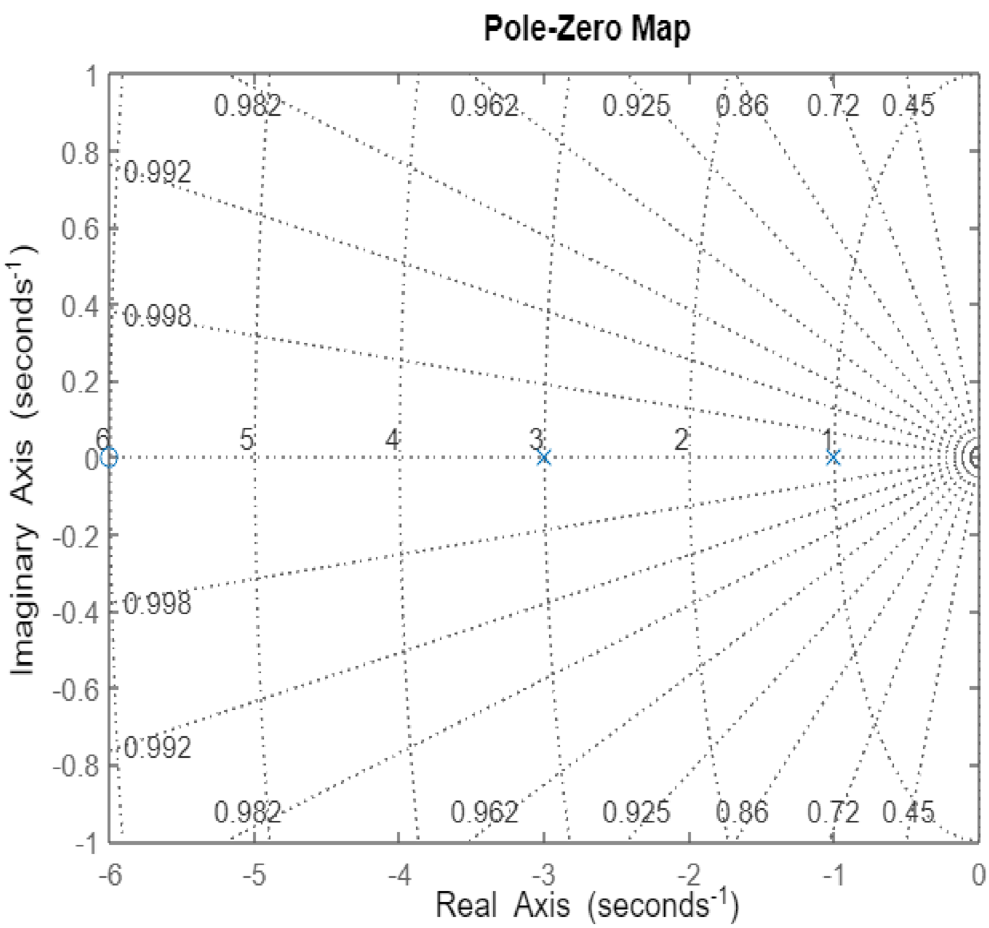
Question VIII:

Write a program that define the transfer functions and plots the zero-pole map of the systems

1. with poles (-1,-3) and zero (-6)
2. with poles (-1, 1+2j and 1-2j) and zero at (-3)

1-

```
system=tf([1 6],[1 4 3]);
%tf=(s+6)/(s+1)*(s+3);
pzplot(system);
grid on
```



Question IX:

Write a program that determine the inverse Laplace and Fourier transforms of the transfer functions in VIII and plot their phase and magnitude spectra.

For the first signal

```
syms s;
ys= (s+6)/((s+1)*(s+3));
yt=ilaplace(ys);
```

```
syms t;
yt= 10*exp(-t)+ 8*dirac(t)+ dirac(1,t);
yf=fourier(yt);
```