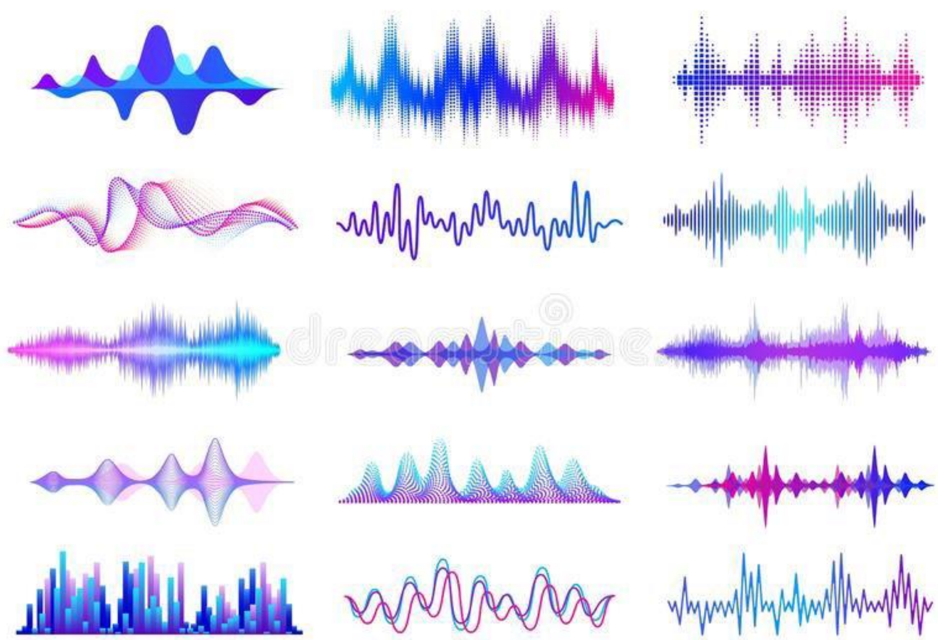
BIRZEIT UNIVERSITY

Faculty Of Engineering and Technology

Electrical And Computer Engineering Department

ENEE2312, Signals & Systems

MATLAB Assignment



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Question #1:

1. Generate and Plot the following signals

   A. $x(t) = \Pi\left[(t-3)/A\right] + \Pi\left[(t-C)/B\right]$

   B. $x_b(t) = r(t) - r(t-A) - r(t-B) + r(t-C)$

Part A: ******A=4, B=9 and C=5*********

Code:

```
 %Fist Signal
t=-2:.0001:15;
pulse= heaviside(t-0.5)-heaviside(t-9.5)+heaviside(t-1)-heaviside(t-5);
plot(t,pulse)
xlabel('Time');
ylabel('x(t)');
title('A-x(t)=u(t-0.5)+u(t-1)-u(t-5)-u(t-9.5)');
```

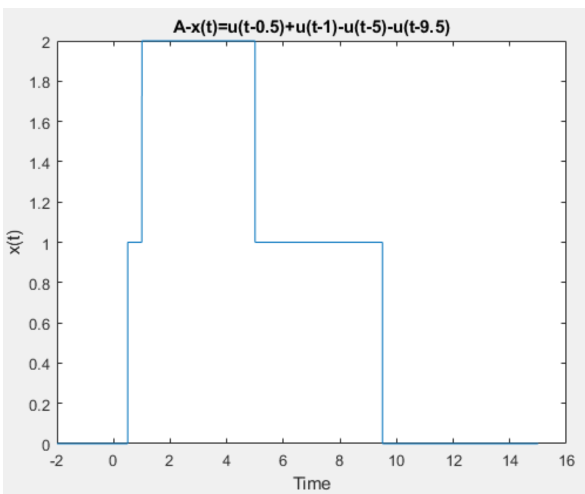

Figure 1(plot the signal of part A)

The signal in part A equals the sum of two signals in terms of unit pulse function, and since the pulse function can be written by using unit step function, so we can express the signal as

x(t)= u(t-0.5+ u(t-1) -u(t-5)-u(t-9.5).

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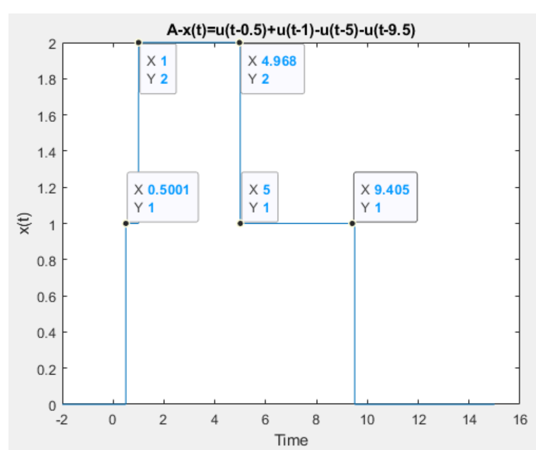
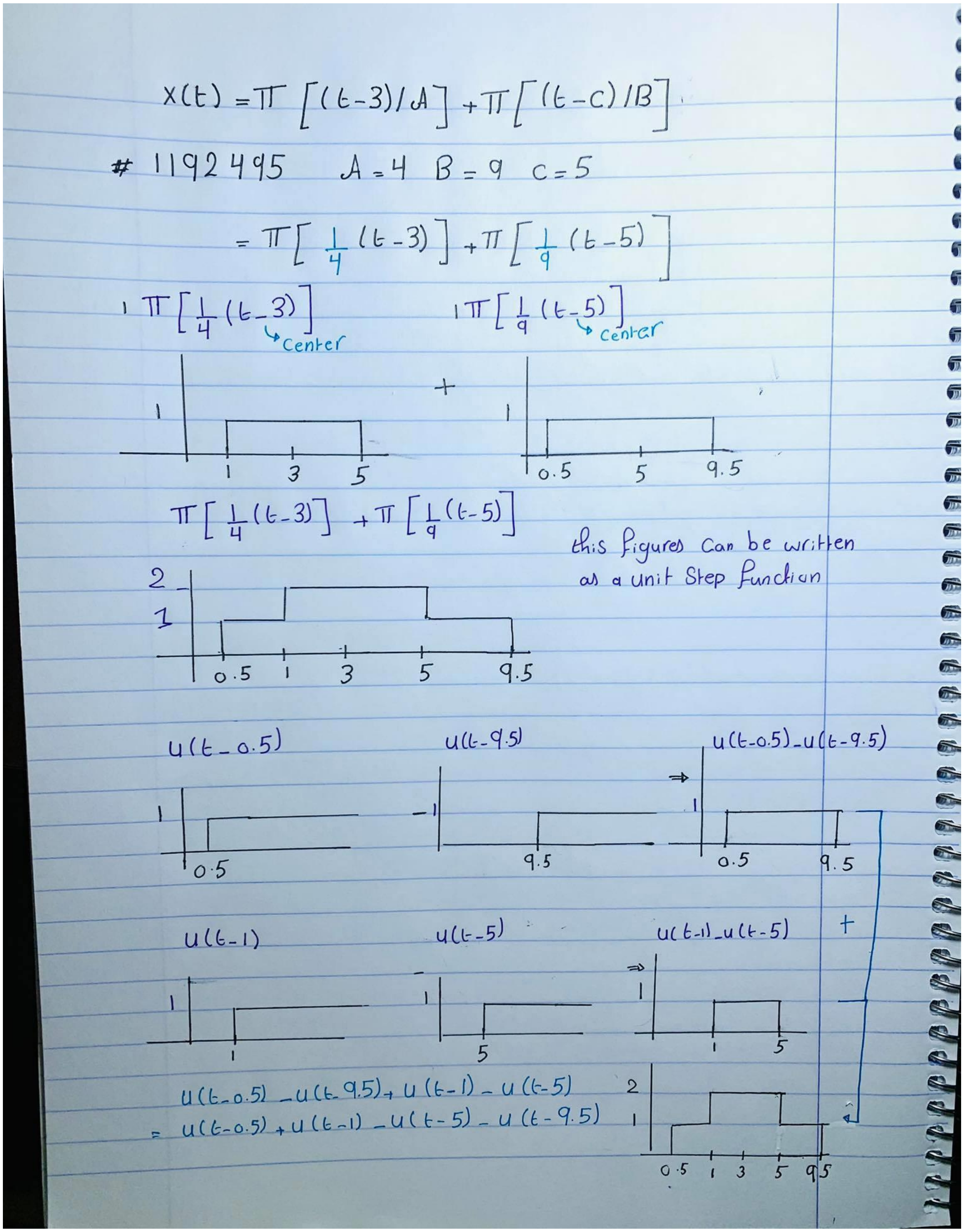




The solution of the part A which is identical to the generated plots by using matlab.

Part B:

Code:

```
%second Signal
% r(t)= t*u(t)
t=0:0.0001:13;
xb= t.*heaviside(t) - (t-4).*heaviside(t-4) + (t-5).*heaviside(t-5) - (t-9).*heaviside(t-9);
plot(t,xb)
xlabel('Time');
ylabel('xb(t)');
title('B-xb(t)=r(t)-r(t-4)+r(t-5)-r(t-9)');
```

code for second signal in part B .

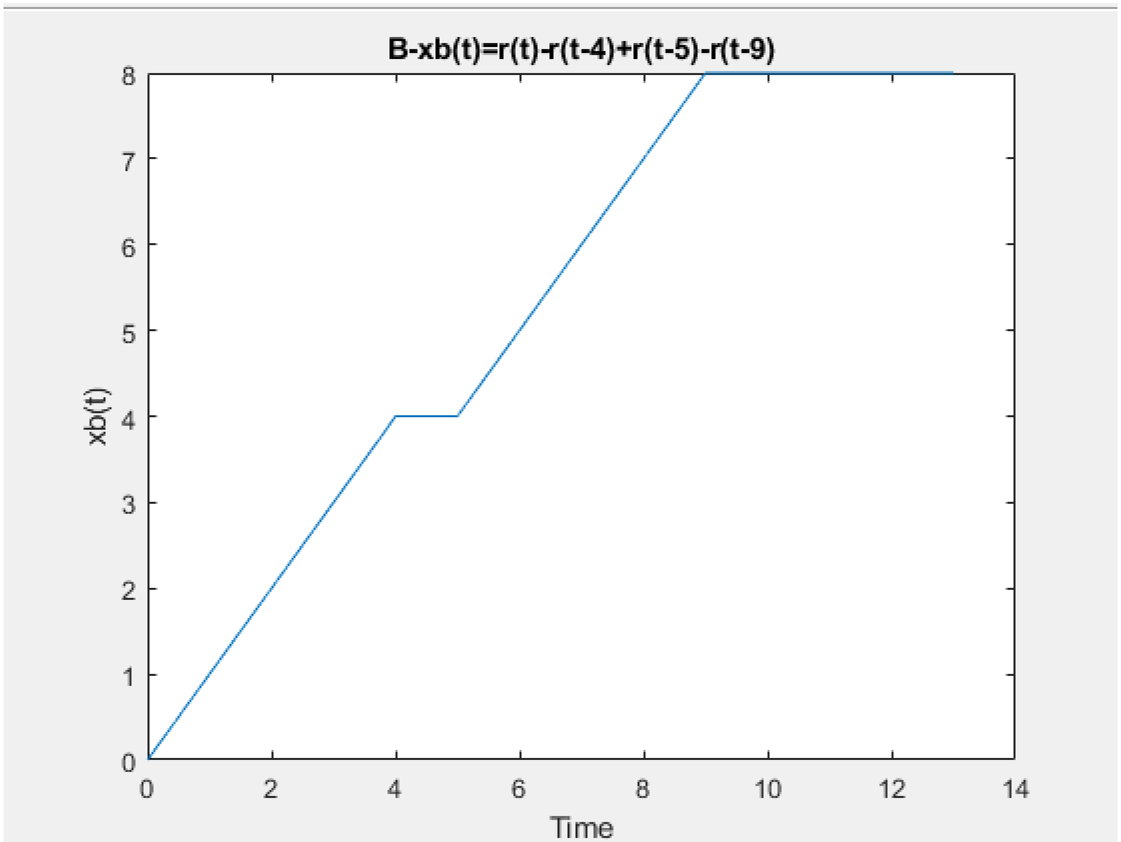


Figure 2(plot xb)

$$X_b(t) = r(t) - r(t-4) + r(t-5) - r(t-9)$$

$1 = x - 0$

$x = 1$

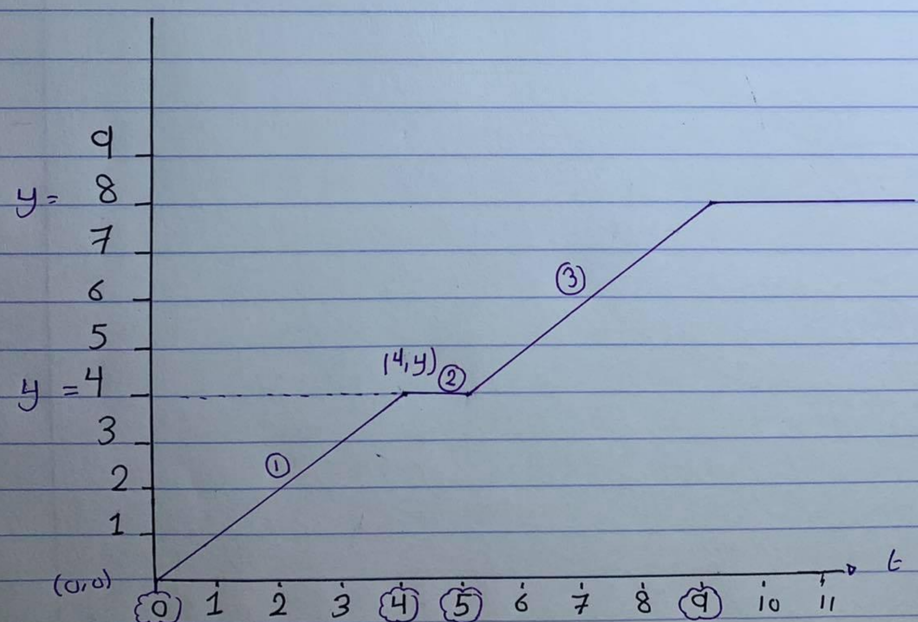
$-1 = x - 1$ ($+1$, $+1$) → $x = 0$

$1 = x - 0$ → $x = 1$

$-1 = x - 1$ ($+1$, $+1$) → $x = 0$

① Slope 1 $= 1 = \frac{y-0}{4-0} \Rightarrow y = 4$

Slop 3 $= 1 = \frac{y-4}{9-5} \Rightarrow y = 8$



2. Consider the following signals:

$$x_1(t) = \sin(10\pi t), \quad x_2(t) = \frac{1}{3}\sin(30\pi t), \quad x_3(t) = \frac{1}{5}\sin(50\pi t)$$

A. Generate and plot $x_1(t)$ for one period.

B. Generate and plot $x_b(t)=x_1(t)+x_2(t)$ for one period.

C. Generate and plot $x_c(t)=x_1(t)+x_2(t)+x_3(t)$ for one period.

Show all the results on one figure using *subplot*

D. Determine, using Matlab plots, if the generated signals are periodic or not.

Code:

```
%Question 2
t=0:0.0001:2*pi;
X1= sin(10*pi*t);
x2=(1/3)*sin(30*pi*t);
x3=(1/5)*sin(50*pi*t);
%xlim([0 0.2]);
%first signal
subplot(2,2,1) ;
plot(t,X1,'r');
%xlim([0 0.2]); %t the limit for one period
xlabel('t axis');
ylabel('X1(t)');
title('Plot of A-sin(10*pi*t)');
%second signal
subplot(2,2,2);
xb= X1+x2;
plot(t,xb,'g');
%xlim([0 0.2]);
xlabel('t axis');
ylabel('X1(t)+ x2(t)');
title('Plot of B-sin(10*pi*t)+(1/3)*sin(30*pi*t)');
%third signal
subplot(2,2,[3 4]);
xc= X1+x2+x3;
plot(t,xc,'k');
%xlim([0 0.2]);
xlabel('t axis');
ylabel('xc=X1(t)+ x2(t)+ x3(t)');
title('Plot of C-sin(10*pi*t)+(1/3)*sin(30*pi*t)+(1/5)*sin(50*pi*t)');
```

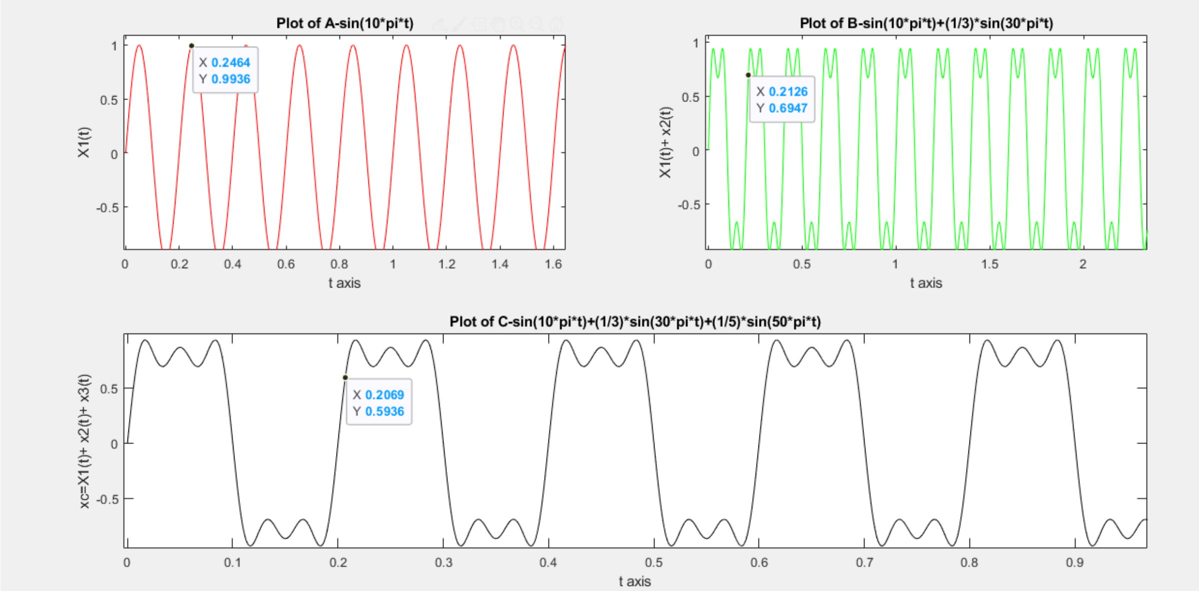


Figure 3(three signals from t=0 to 2*pi)

By looking into figure 3 it is easily to see that the three generated signals are periodic. And we can conclude that the one period for the signals in this question is from 0 to 0.2, and we also can conclude this by calculating the period and fundamental frequency.

For the signal X1(t)= Sin (10*pi*t) ----- W=2*pi *f=2*pi/T0 so T0=(2*pi)/(10*pi) = (0.2) and f=5Hz which is real number so the signal is periodic. We can use this way to find the one period for the other signals.

The other signals in part 2 and 3 also have T0=0.2, so that we can add **xlim([0 0.2])** to the code to generate and plot the signals for one period. Hence, the code and the generated signals for one period will be:

```
%Question 2
t=0:0.0001:2*pi;
X1= sin(10*pi*t);
x2=(1/3)*sin(30*pi*t);
x3=(1/5)*sin(50*pi*t);
xlim([0 0.2]);
%first signal
subplot(2,2,1) ;
plot(t,X1,'r');
xlim([0 0.2]); %t the limit for one period
xlabel('t axis');
ylabel('X1(t)');
title('Plot of A-sin(10*pi*t)');
%second signal
subplot(2,2,2);
xb= X1+x2;
plot(t,xb,'g');
xlim([0 0.2]);
xlabel('t axis');
ylabel('X1(t)+ x2(t)');
title('Plot of B-sin(10*pi*t)+(1/3)*sin(30*pi*t)');
%third signal
subplot(2,2,[3 4]);
xc= X1+x2+x3;
plot(t,xc,'k');
xlim([0 0.2]);
xlabel('t axis');
ylabel('xc=X1(t)+ x2(t)+ x3(t)');
title('Plot of C-sin(10*pi*t)+(1/3)*sin(30*pi*t)+(1/5)*sin(50*pi*t)');
```

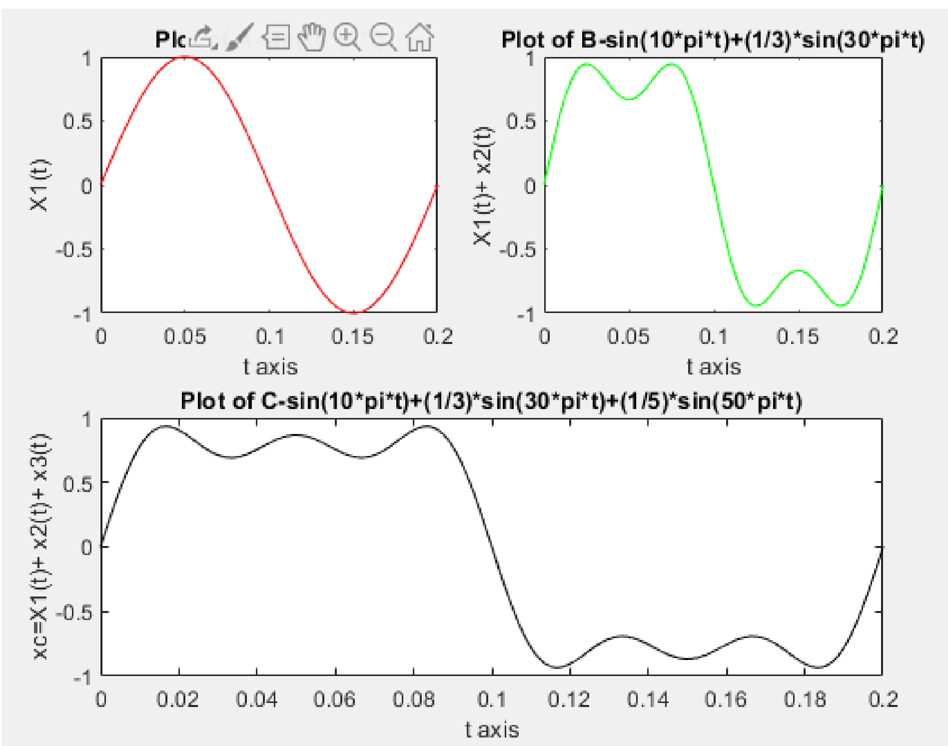


Figure 4(plot and generate the signals for one period)

Question #3:

3. Find and sketch the signal y(t) which is the convolution of the two pairs if signals.

$$x(t)=\left[e^{-2t}-Ce^{-10t}\right]u(t), \quad h(t)=\Pi\left(\frac{t-B}{A}\right)$$

Code:

```
%Question #3
syms t taw ;
x(t)=(exp(-2.*taw)-5.*exp(-10.*taw)).*(heaviside(taw));
h(t)=(heaviside(t-taw-7)-heaviside(t-taw-11));
conv_answer=int(x(t)*h(t),taw,-inf,inf);
fplot(conv_answer);
xlabel('Time');
ylabel('conv-answer');
title('Convolution');
axis([0 20 -2 2]);
```

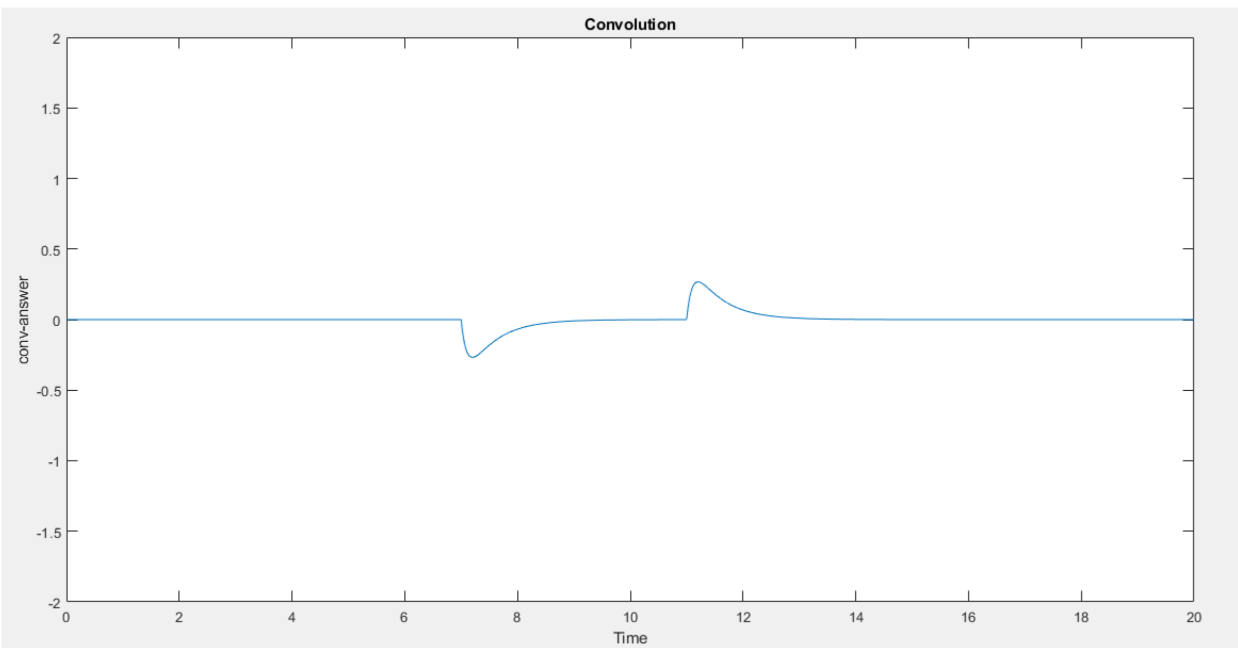


Figure 5(convolution)

Question #4:

4. Consider the following Differential Equation

$$\frac{d^2y(t)}{dt^2} + A\frac{dy(t)}{dt} + By(t) = C + 5\cos(1500\,t)$$

A. Solve it (write code) for $t \geq 0$ using zero initial conditions.

B. Determine the response of the LTI systems for the given input and initial conditions: $y(0)=0, y'(0)=A$

Code for part A:

```
%question 4
syms y(t)
dy=diff(y,t);
fun=diff(y,t,2)== 5+(5*cos(1500*t))-(4*dy)-(9*y);
con1=y(0)==0;
con2=dy(0)==0;
conds=[con1 con2];
sol=dsolve(fun,conds)
simple_sol=simplify(sol)
```

```
sol =

cos(5^(1/2)*t)*((5*cos(5^(1/2)*t))/9 - (1249995*cos(1500*t +
5^(1/2)*t))/1124999000018 - (1249995*cos(1500*t - 5^(1/2)*t))/1124999000018 +
(5000*sin(1500*t + 5^(1/2)*t))/1687498500027 + (5000*sin(1500*t -
5^(1/2)*t))/1687498500027 - (2*5^(1/2)*sin(5^(1/2)*t))/9 +
(562499750*5^(1/2)*cos(1500*t + 5^(1/2)*t))/1687498500027 -
(562499750*5^(1/2)*cos(1500*t - 5^(1/2)*t))/1687498500027 -
(250001*5^(1/2)*sin(1500*t + 5^(1/2)*t))/562499500009 +
(250001*5^(1/2)*sin(1500*t - 5^(1/2)*t))/562499500009) - (2812486250090*exp(-
2*t)*cos(5^(1/2)*t))/5062495500081 + sin(5^(1/2)*t)*((5*sin(5^(1/2)*t))/9 -
(5000*cos(1500*t + 5^(1/2)*t))/1687498500027 + (5000*cos(1500*t -
5^(1/2)*t))/1687498500027 - (1249995*sin(1500*t + 5^(1/2)*t))/1124999000018 +
(1249995*sin(1500*t - 5^(1/2)*t))/1124999000018 +
(2*5^(1/2)*cos(5^(1/2)*t))/9 + (250001*5^(1/2)*cos(1500*t +
5^(1/2)*t))/562499500009 + (250001*5^(1/2)*cos(1500*t -
5^(1/2)*t))/562499500009 + (562499750*5^(1/2)*sin(1500*t +
5^(1/2)*t))/1687498500027 + (562499750*5^(1/2)*sin(1500*t -
5^(1/2)*t))/1687498500027) - (1125003500036*5^(1/2)*exp(-
2*t)*sin(5^(1/2)*t))/5062495500081


simple_sol =

(10000*sin(1500*t))/1687498500027 - (1249995*cos(1500*t))/562499500009 -
(2812486250090*exp(-2*t)*cos(5^(1/2)*t))/5062495500081 -
(1125003500036*5^(1/2)*exp(-2*t)*sin(5^(1/2)*t))/5062495500081 + 5/9
```

Code for part B:

```
%question 4
syms y(t)
dy=diff(y,t);
fun=diff(y,t,2)== 5+5*cos(1500*t)-4*dy-9*y;
con1=y(0)==0;
con2=dy(0)==4;
conds=[con1 con2];
sol=dsolve(fun,conds)
simple_sol=simplify(sol)
```

sol =

cos(5^(1/2)*t)*((5*cos(5^(1/2)*t))/9 - (1249995*cos(1500*t + 5^(1/2)*t))/1124999000018 - (1249995*cos(1500*t - 5^(1/2)*t))/1124999000018 + (5000*sin(1500*t + 5^(1/2)*t))/1687498500027 + (5000*sin(1500*t - 5^(1/2)*t))/1687498500027 - (2*5^(1/2)*sin(5^(1/2)*t))/9 + (562499750*5^(1/2)*cos(1500*t + 5^(1/2)*t))/1687498500027 - (562499750*5^(1/2)*cos(1500*t - 5^(1/2)*t))/1687498500027 - (250001*5^(1/2)*sin(1500*t + 5^(1/2)*t))/562499500009 + (250001*5^(1/2)*sin(1500*t - 5^(1/2)*t))/562499500009) - (2812486250090*exp(-2*t)*cos(5^(1/2)*t))/5062495500081 + sin(5^(1/2)*t)*((5*sin(5^(1/2)*t))/9 - (5000*cos(1500*t + 5^(1/2)*t))/1687498500027 + (5000*cos(1500*t - 5^(1/2)*t))/1687498500027 - (1249995*sin(1500*t + 5^(1/2)*t))/1124999000018 + (1249995*sin(1500*t - 5^(1/2)*t))/1124999000018 + (2*5^(1/2)*cos(5^(1/2)*t))/9 + (250001*5^(1/2)*cos(1500*t + 5^(1/2)*t))/562499500009 + (250001*5^(1/2)*cos(1500*t - 5^(1/2)*t))/562499500009 + (562499750*5^(1/2)*sin(1500*t + 5^(1/2)*t))/1687498500027 + (562499750*5^(1/2)*sin(1500*t - 5^(1/2)*t))/1687498500027) + (14624964500144*5^(1/2)*exp(-2*t)*sin(5^(1/2)*t))/25312477500405

simple_sol =

(10000*sin(1500*t))/1687498500027 - (1249995*cos(1500*t))/562499500009 - (2812486250090*exp(-2*t)*cos(5^(1/2)*t))/5062495500081 + (14624964500144*5^(1/2)*exp(-2*t)*sin(5^(1/2)*t))/25312477500405 + 5/9