FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ENEE 2313
SIGNAL AND SYSTEMS

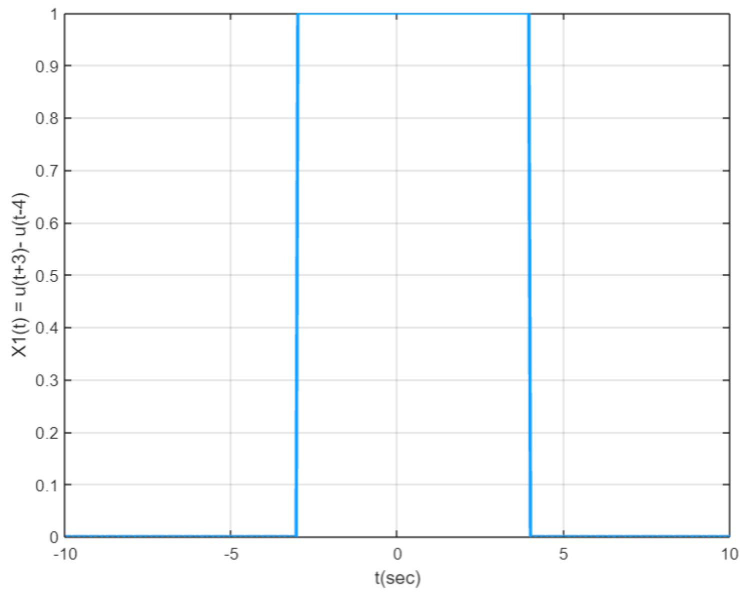
“ MATLAB ASSIGNMENT “

Student’s name: Sara Issa Student’s ID: 1190673
Teacher’s name: Dr. Ashraf Al-Rimawi Date: 20/8/2021
Section: 2

Table of Contents:

Question I:

1. X1(t) = u(t+3)- u(t-4): initially u(t+3), u(t-4), and u(t+3)-u(t-4) was drawn, then from result the range value of t equal [-3,4], by using the matlab program, the same result was obtained as shown in Figure NO.1.1:

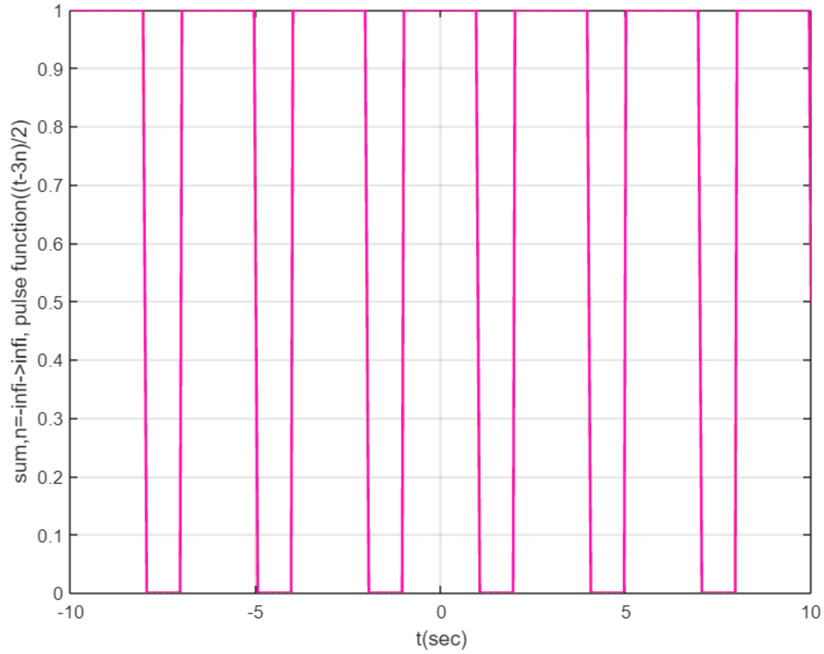


Here is the code of X1(t):

```
% Function for generating a unit step.
function u=stp_fn(t)
u=0.5.*(sign(t+eps) + 1);
end
```

```
% Question I, X1(t) = u(t+3)- u(t-4): by using step function (stp_fn(t)).
clear all % to remove all variables from workspace.
close all % to close all previous codes.
clc % clears the command window
t=-10:0.05:10; % seconds
x=stp_fn(t+3)-stp_fn(t-4);
plot (t,x) % plot the signal versus time
xlabel (' t(sec) ') % to put t(sec) under x axis
ylabel (' X1(t) = u(t+3)- u(t-4) ') %to put X1(t) = u(t+3)- u(t-4)  next to y axis
```

2. A finite pulse $\sum_{n=-infi}^{infi} \prod((t-3n)/2)$: by using pls_fn(t), an equation has been written, and the range value of t equal [-infi,infi], by using the matlab program, the result was as shown in Figure NO.1.2:

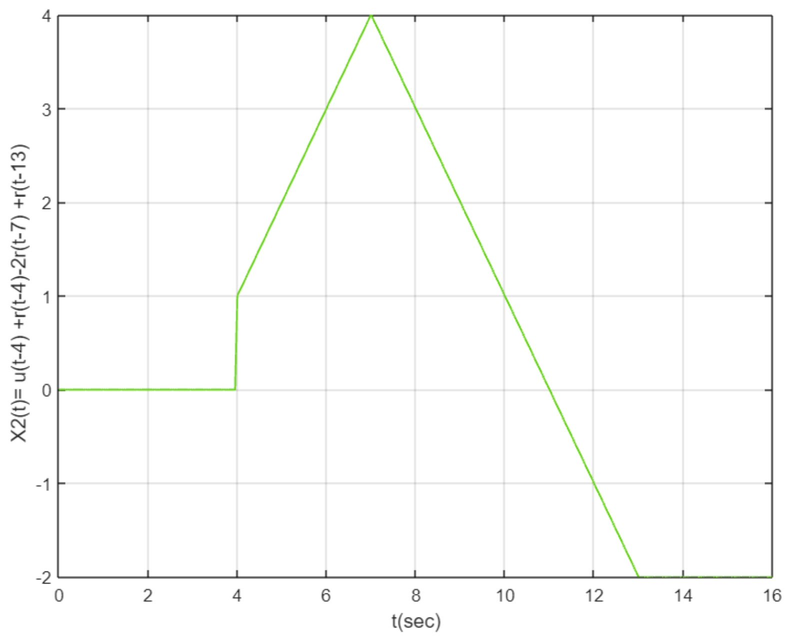


Here is the code of $\sum_{n=-infi}^{infi} \prod((t-3n)/2)$):

```
% This function generates a unit-high pulse centered at zero, and extending from -1/2
to 1/2
function y=pls_fn(t)
y = stp_fn (t+0.5 ) - stp_fn (t - 0.5 - eps);
end
```

```
% Question I, by using pulse function(pls_fn(t)).
clear all % to remove all variables from workspace.
close all % to close all previous codes.
clc % clears the command window
t=-10:0.05:10; % seconds
infi = floor ((max(abs(t)) + 1) / 3) +1;
result = 0; % initial value of the result
for n=-infi:infi % for loop (from n=-infi to n=infi)
    P = pls_fn((t - (3*n)) / 2); % the pulse equation
    result = P + result;
end
plot (t,result) % plot the signal versus time
xlabel (' t(sec) ') % to put t(sec) under x axis
ylabel (' sum,n=-infi->infi, pulse function((t-3n)/2) ') %to put sum,n=-infi->infi,
pulse function((t-3n)/2) next to y axis
```

3. X2(t)= u(t-4) +r(t-4)-2r(t-7) +r(t-13) in the time interval [0,16]: by using stp fn(t) and rmp_fn(t), an equation X2(t) has been written, and the range value of t equal [0,16], by using the matlab program, the result was as shown in Figure NO.1.3:



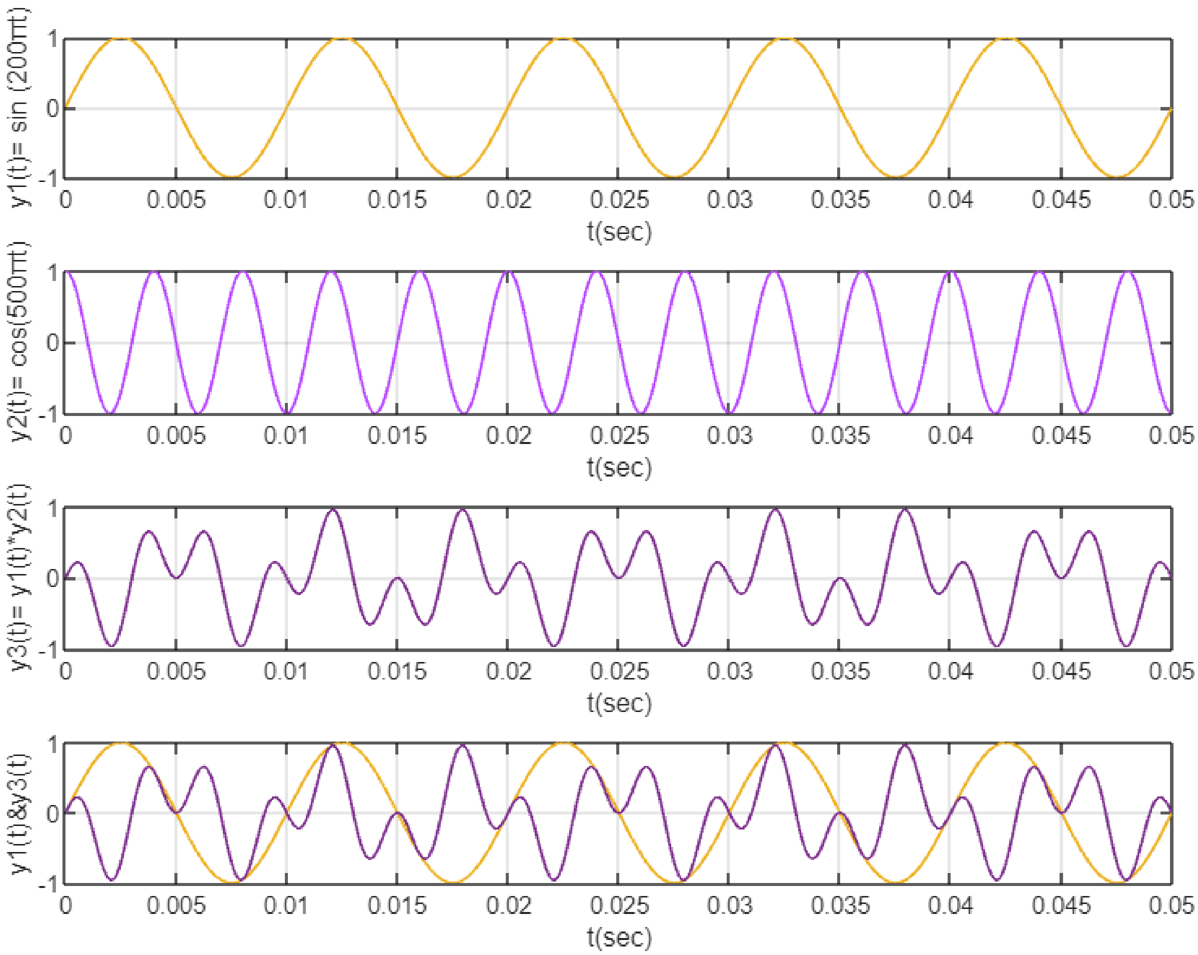
Here the code of X2(t):

```
% Function for generating a unit ramp
function r=rmp_fn(t)
r=0.5*t.*(sign(t)+1);
end
```

```
% Question I, X2(t)= u(t-4) +r(t-4)-2r(t-7) +r(t-13): by using step function
(stp_fn(t)) & ramp function (rmp_fn(t)).
clear all % to remove all variables from workspace.
close all % to close all previous codes.
clc % clears the command window
t=0:0.05:16; % seconds
x=stp_fn(t-4)+rmp_fn(t-4)-2*rmp_fn(t-7)+rmp_fn(t-13);
plot(t,x) % plot the signal versus time
xlabel (' t(sec) ') % to put t(sec) under x axis
ylabel ('  X2(t)= u(t-4) +r(t-4)-2r(t-7) +r(t-13) ') %to put X2(t)= u(t-4)+r(t-4)-
2r(t-7)+r(t-13) next to y axis
```

Question II: y1(t)= sin (200πt), and y2(t)= cos(500πt):

At first y1(t), y2(t), the product of two signals, and y1(t) and the product of two signals in the same X -Y axis were drawn as shown in figure NO.2:



By using this identical : $\sin a \cos b = \frac{1}{2}[\sin(a+b) + sin(a-b)]$, the value of the product of two signals = (sin (700*pi*t) + sin (-300*pi*t)) / 2, and as shown in the previous figure this signal is periodic, then To = 0.02 sec and fo = 1/To = 50 Hz.

Here is the code of question II:

```
% Question II, y1(t)= sin (200πt), y2(t)= cos(500πt), then determine y1 and plot the
product of two signals.
clear all % to remove all variables from workspace.
close all % to close all previous codes.
clc % clears the command window
syms t;
x= sin (200*pi*t); %  y1(t)= sin (200πt)
y= cos(500*pi*t); % y2(t)= cos(500πt)
z= (sin (700*pi*t) + sin (-300*pi*t)) / 2; % y3(t)= y1(t) * y2(t)
subplot(4,1,1), fplot(x), xlabel ('t(sec)'), ylabel('y1(t)= sin (200πt)') % to plot
y1(t)
axis([0 0.05 -1 1]) % x axis from 0 to 0.05, and y axis from -1 to 1
subplot(4,1,2), fplot(y), xlabel ('t(sec)'), ylabel('y2(t)= cos(500πt)') % to plot
y2(t)
axis([0 0.05 -1 1]) % x axis from 0 to 0.05, and y axis from -1 to 1
subplot(4,1,3), fplot(z), xlabel ('t(sec)'), ylabel('y3(t)= y1(t)*y2(t)')  % to plot
y3(t)
axis([0 0.05 -1 1]) % x axis from 0 to 0.05, and y axis from -1 to 1
subplot(4,1,4), fplot(x), hold on, fplot(z), xlabel ('t(sec)'), ylabel('y1(t)&y3(t)')
% to plot y1(t) and y3(t)
axis([0 0.05 -1 1]) % x axis from 0 to 0.05, and y axis from -1 to 1
```

Question III:

$$\frac{dy(t)}{dt} + 30y(t) = 20$$

Here is the code of question 3:

```
% Function for generating a unit step.
function u=stp_fn(t)
u=0.5.*(sign(t+eps) + 1);
end
```

```
% Question III, solve the differential equation (for t>0) using zero initial
conditions.
clear all % to remove all variables from workspace.
close all % to close all previous codes.
clc % clears the command window.

syms t y(t)
differentialEquation = diff(y,t) + 30*y(t) == 20; % The differential equation
zeroInitialConditions = y(0) == 0; % zero initial condition
ySol(t) = dsolve(differentialEquation, zeroInitialConditions) % The solution

t = 0:0.001:1; % seconds
x = 20*stp_fn(t); % x(t) = 20.*u(t)

digits(5);
y = double(vpa(ySol(t)));
freq = -100:1:100; % hertz (Hz)
dt = t(2)-t(1);
for f = 1:length(freq)
X(f) = sum(x.*exp(-2*1i*pi*freq(f)*t))*dt; % to calculate the value of X(f)
Y(f) = sum(y.*exp(-2*1i*pi*freq(f)*t))*dt; % to calculate the value of Y(f)
H(f) = Y(f)/X(f); % to calculate the value of H(f)
end

subplot (2,1,1), plot(freq,abs(H)), ylabel('|H(f)|'), xlabel('frequency(Hz)')
subplot (2,1,2), plot(freq,angle(H)), ylabel('{\angle}H(f)'), xlabel('frequency(Hz)')
```

After click on Run, the result is:

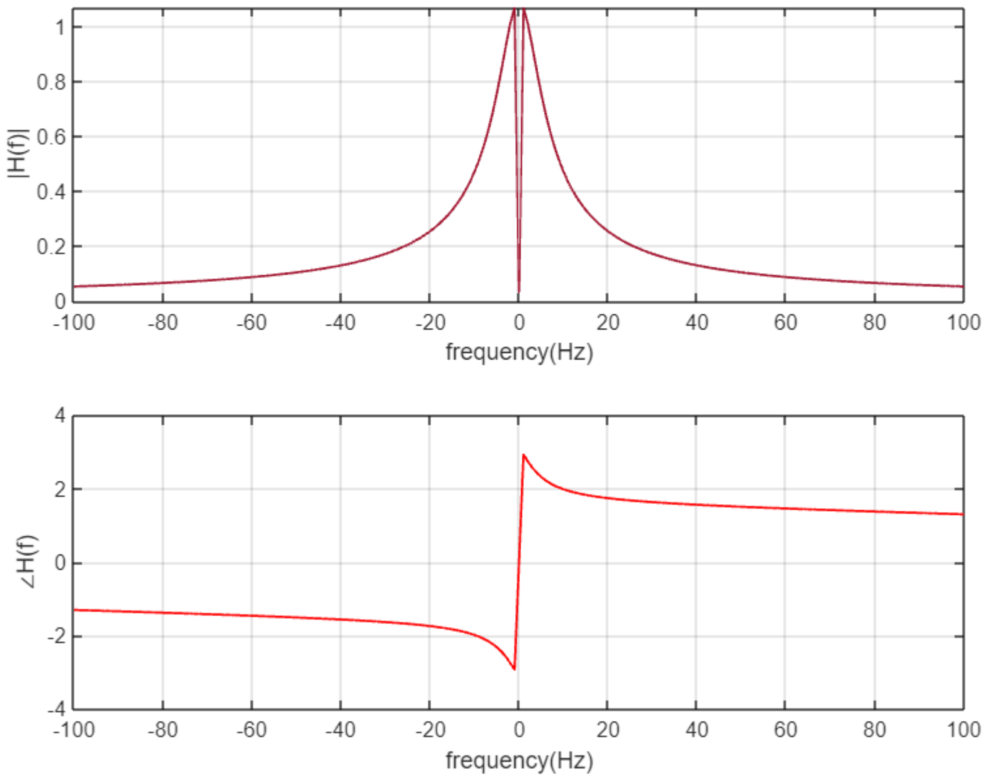
```
Command Window
New to MATLAB? See resources for Getting Started.

ySol(t) =

2/3 - (2*exp(-30*t))/3

>> grid
```

The plot of the magnitude and phase of the Transfer Function H(f), as shown on figure NO.3:



Evaluate the Fourier Transform of the Transfer Function H(f)=Y(f)/X(f):

$F[\frac{dy(t)}{dt} + 30y(t)] = F[20]$

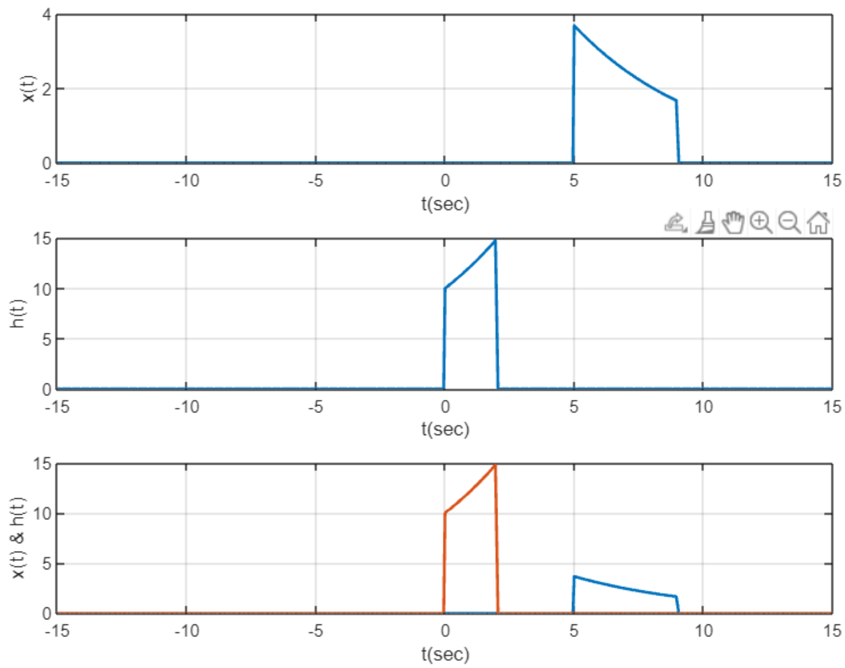
$= j2\pi f\, Y(f) + 30\, Y(f) = \frac{20}{j2\pi f}$, X(f) = $\frac{20}{j2\pi f}$

$= (j2\pi f + 30)Y(f) = X(f)$

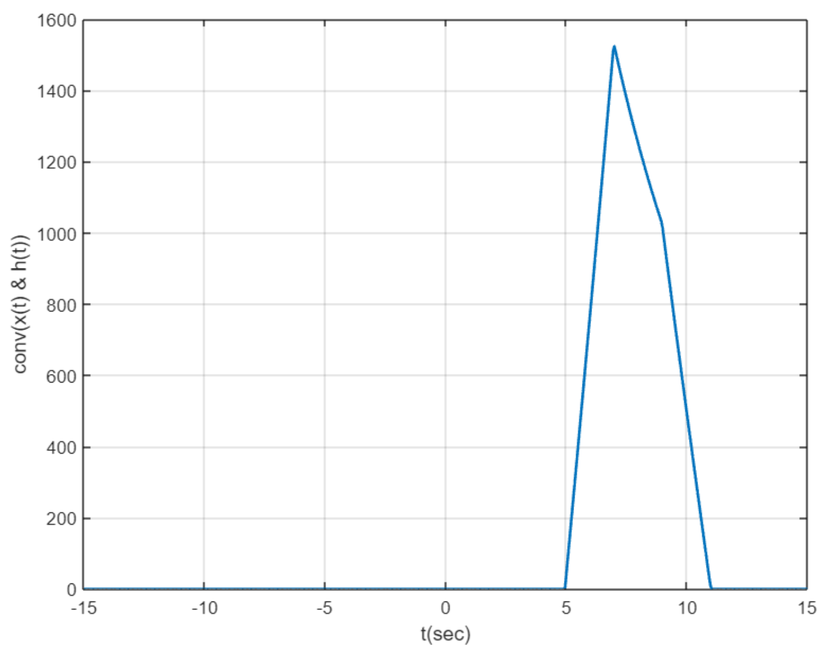
$But\ \mathrm{H(f) = Y(f)/X(f)} = \frac{1}{(j2\pi f + 30)}$

Question IV: X(t) = $(10e^{(-0.2t)})\pi((t-7)/4)$, and H(t) = $(10e^{(0.2t)})\ \pi((t-1)/2)$:

At first x(t), h(t), and x(t)&(t) in the same X -Y axis were drawn as shown in figure NO.4.1:



Then, y(t) has a nonzero value when 5 ≤ t ≤ 11, and it has zero value when t ≤ 5 && t ≥ 11, the result of the convolution was as shown on figure NO.4.2:



Here is the code of question IV:

```
% Question IV,  convolution of the functions x(t) and h(t): by using exp function and
pulse function(pls_fn(t)).
clear all % to remove all variables from workspace.
close all % to close all previous codes.
clc % clears the command window
t=-15:0.05:15; % seconds
x= 10.*exp(-0.2*t) .*pls_fn((t-7)/4);
h= 10.*exp(0.2*t) .*pls_fn((t-1)/2);
c= conv(x,h,'same');
subplot(3,1,1), plot(t,x), xlabel ('t(sec)'), ylabel('x(t)') % to plot x(t)
subplot(3,1,2), plot(t,h), xlabel ('t(sec)'), ylabel('h(t)') % to plot h(t)
subplot(3,1,3), plot(t,x,t,h), xlabel ('t(sec)'), ylabel('x(t) & h(t)')  % to plot
x(t) and h(t)
figure, plot(t,c), xlabel ('t(sec)'), ylabel('conv(x(t) & h(t))')  % to plot
conv(x(t) & h(t))
```