BIRZEIT UNIVERSITY

Faculty of Engineering and Technology Department of Electrical and Computer Engineering Signals and Systems ENEE 2312 Suggested Problems-Chapter One MATLAB Assignment-Part Two

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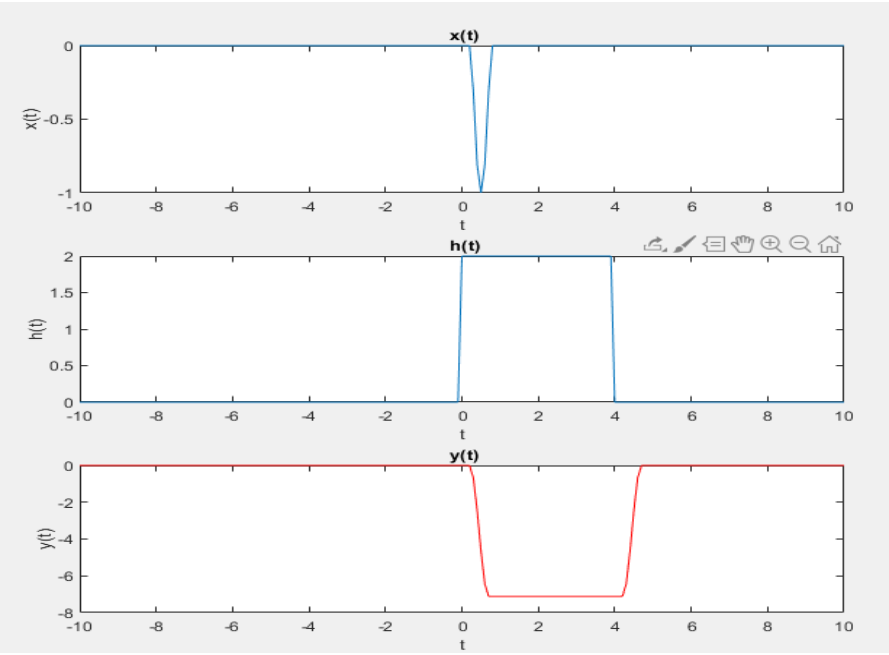
- INSTRUCTOR: Dr. Ashraf Alrimawi.
- Section : 3.
- Date : 9/9/2023 .

Question 1

```
% Abdelrhman abed 1193191
t = -10:0.1:10;
w0=2*pi*t;
h = 2 * rectpuls((t-2)/4);
x = cos(w0) .* rectpuls((t-0.5)/0.5);
y = conv(x, h, 'same') * 1.1;

subplot(3,1,1);
plot(t, x);
title(' x(t)');
xlabel('t');
ylabel('x(t)');

subplot(3,1,2);
plot(t, h);
title(' h(t)');
xlabel('t');
```

```
 8 -    subplot(3,1,1);
 9 -    plot(t, x);
10 -    title(' x(t)');
11 -    xlabel('t');
12 -    ylabel('x(t)');
13
14 -    subplot(3,1,2);
15 -    plot(t, h);
16 -    title(' h(t)');
17 -    xlabel('t');
18 -    ylabel('h(t)');
19
20 -    subplot(3,1,3);
21 -    plot(t, y,'r');
22 -    title(' y(t)');
23 -    xlabel('t');
24 -    ylabel('y(t)');
```



Question 2

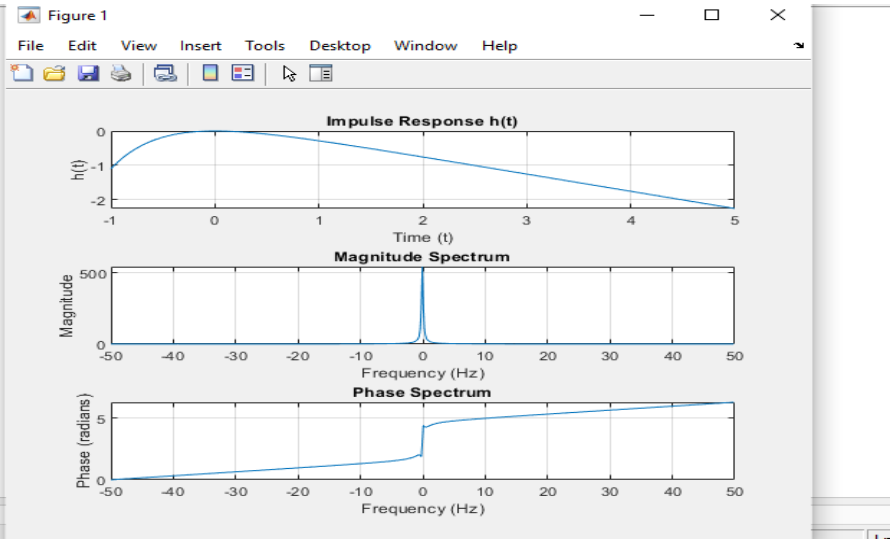
```
syms y(t) t
dy=diff(y,t);
second=diff(y,t,t);
equ=second + 2*dy + 1 -2 * dirac(t,2);
solution= dsolve(equ,y(0)==0,dy(0)==0);
disp('h(t)');
disp(solution);
```

Command Window

```
h(t)
1/4 - exp(-2*t)/4 - t/2
```

```
%abdelrhman abed 1193191
syms t
sol = 1/4 - exp(-2*t)/4 - t/2;
h_of_t = matlabFunction(sol);
t1 = -1:0.01:5;
h1= h_of_t(t1);
N = length(h1);
H = fft(h1);
fs = 1 / (t1(2) - t1(1));
f = (-N/2:N/2-1) * fs / N;
magnitude_spectrum = abs(fftshift(H));
phase_spectrum = unwrap(angle(fftshift(H)));
subplot(3, 1, 1);
plot(t1, h1);
xlabel('Time (t)');
ylabel('h(t)');
title('Impulse Response h(t)');
grid on;
subplot(3, 1, 2);
plot(f, magnitude_spectrum);
xlabel('Frequency (Hz)');
ylabel('Magnitude');
title('Magnitude Spectrum');
grid on;
subplot(3, 1, 3);
```

and Window



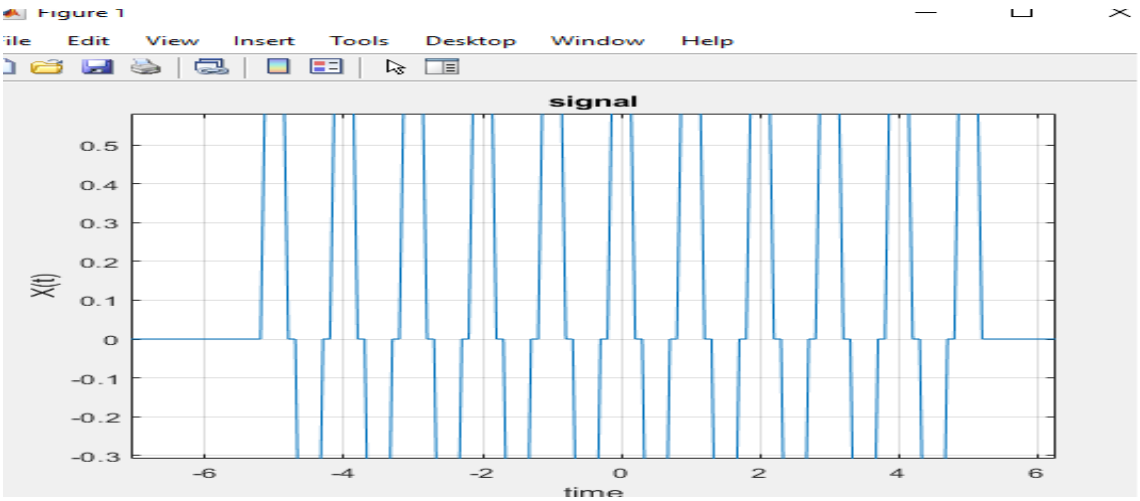

```
subplot(3, 1, 3);
plot(f, phase_spectrum);
xlabel('Frequency (Hz)');
ylabel('Phase (radians)');
title('Phase Spectrum');
grid on;
subplot(3, 1, 1);
ylim([min(h1), max(h1)]);
subplot(3, 1, 2);
ylim([0, max(magnitude_spectrum)]);
```

Question 3

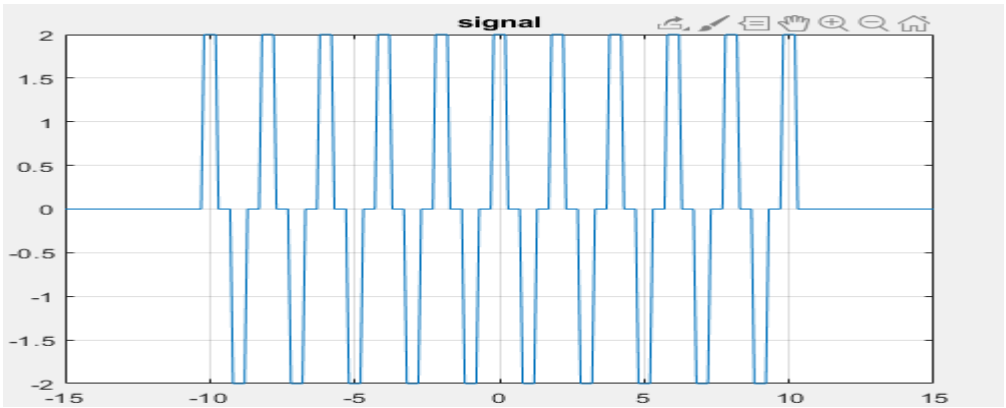
A: Express the periodic signal x(t) in terms of singularity function. Write Matlab source code to plot this signal and Validate your.

```
%abdelrhman abed 1193191
t=-15:.1:15;
T0=input('the value of T0:');
A=input('the value of A:');
x1 = 0;
for n = -10:10;
    x1_n = ((-1)^n) * (A) * rectpuls((t - n*T0/2) / (T0/4));

    x1 = x1 + x1_n;
end

plot(t,x1);
xlabel('time');
ylabel('X(t)');
title('signal');
grid on;
```

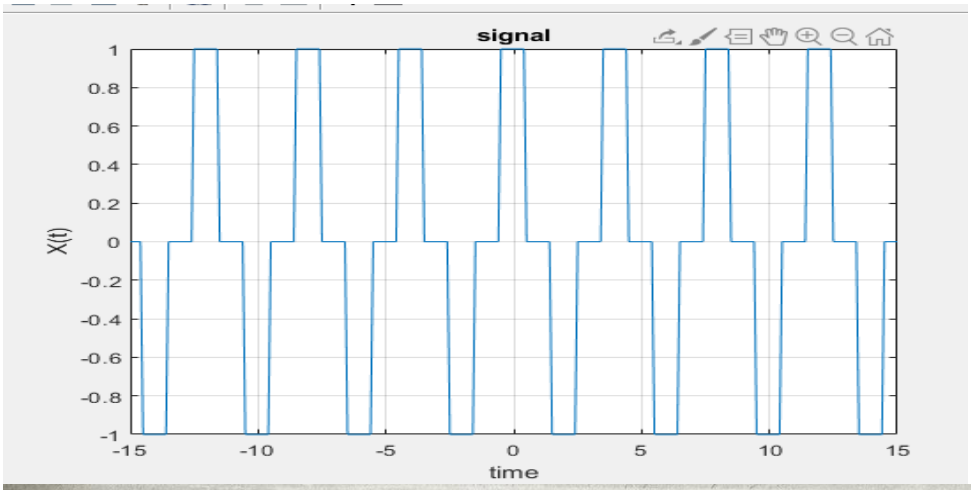
When T0= 1 and A=1



When T0=2 and A=2



When T0=2 and A=2



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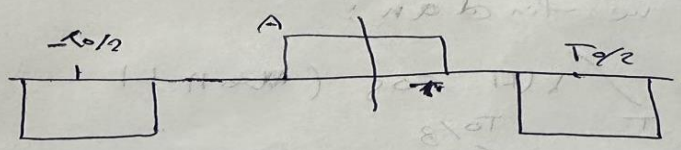
#Q 3 8

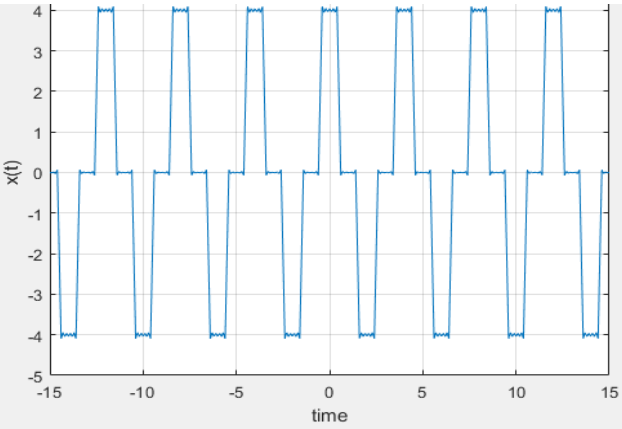
A 8 $x(t) = \sum_{n=-\infty}^{\infty} A\,\Pi\left(\frac{t - n\frac{T_0}{2}}{T_0/4}\right)$



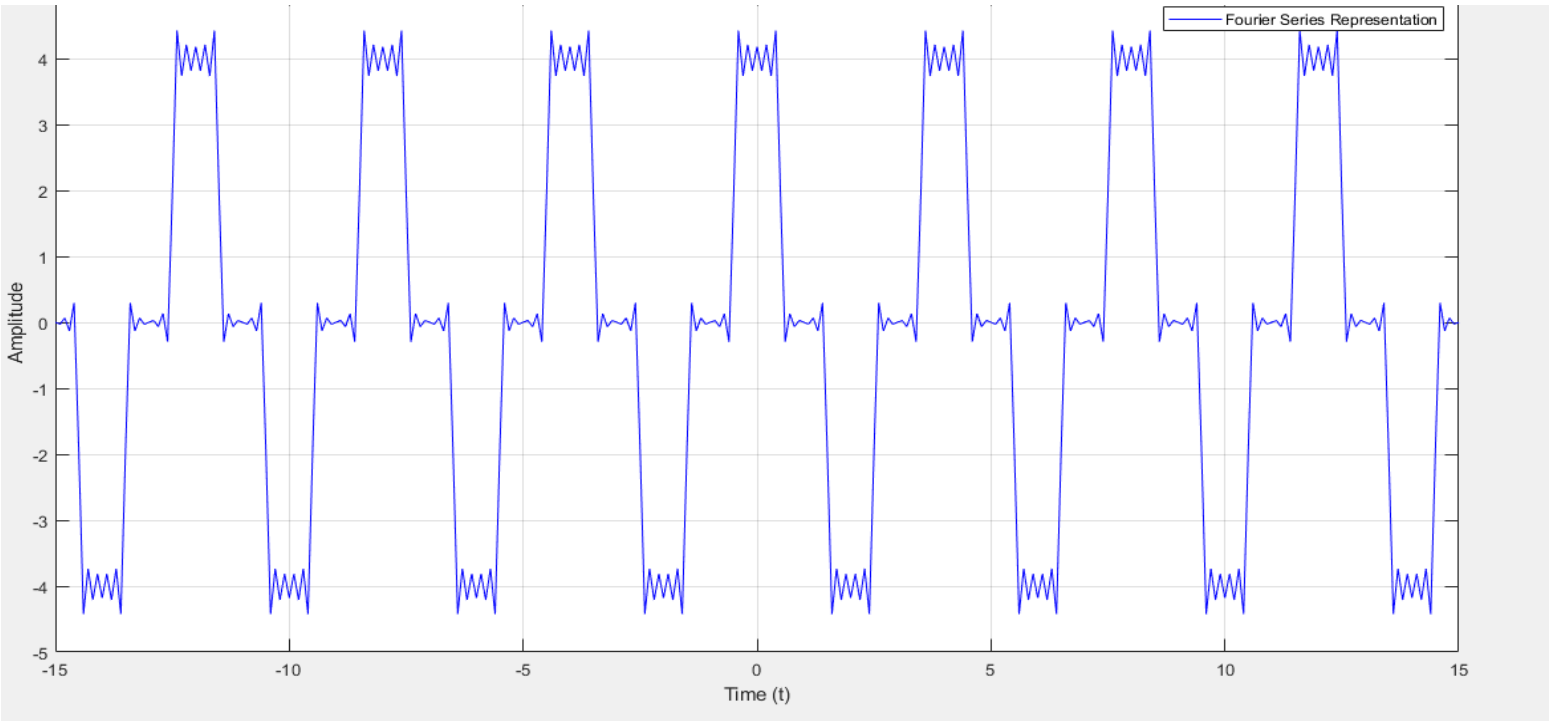
* لاحظنا $(-1)^n$ عكان نحدد وه فوق وهوه تحت فقط البسات
* وبيجه $T_0/4$ وهي عرض البلس
* وبيجه $T_0/2$ هي مقدار التشت

B: Express the periodic signal x(t) in terms of Fourier series expression. Write Matlab source code to plot this signal and Validate your.

```
% abdelrhman abed 119391
T0 = input('Enter the value of T0: ');
A = input('Enter the value of A: ');
t = -15:0.1:15;
f0 = 1/T0;
N = 100;
x = 0;
an = @(n) (A/(n*pi)) * (2*sin(pi*n/4) - sin(5*pi*n/4) + sin(3*pi*n/4));
for n = 1:N
    x = x +an(n) * cos(2*pi*n*f0*t);
end
plot(t,x);
xlabel('time');
ylabel('x(t)');
title('fourier series of x(t)');
```




```
Command Window
>> Untitled3
Enter the value of T0: 4
Enter the value of A: 4
>> Untitled3
Enter the value of T0: 4
Enter the value of A: 4
>> Untitled3
Enter the value of T0: 4
Enter the value of A: 4
>>
```



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Q 3

Bs we used Trigonmetric touriesseries

① Because the x(t) is horizantal and even fu
ao = 0
bn = 0

② Now we find an:

$$an = \frac{2}{To} \int_{T} x(t) \cos(won t)$$

$$an = \frac{2}{To} \int_{-To/8}^{To/8} A\cos(won t) + \int_{3To/8}^{5To/8} -A\cos(won t$$

$$an = \frac{2A}{To} \left(\frac{\sin(won t)}{won} \right) \Bigg|_{-To/8}^{To/8}$$

$$- \left(\frac{\sin(won t)}{won} \right) \Bigg|_{3To/8}^{5To/8}$$

$$an = \frac{2A}{To\, won} \left(\sin\left(won \frac{To}{8}\right) - \sin\left(-won \frac{To}{8}\right) \right.$$

$$\left. - \left(\sin\left(won \frac{5To}{8}\right) - \sin\left(won \frac{3To}{8}\right) \right) \right)$$

we Now = $wo = \frac{2\pi}{To}$

$$a_n = \frac{2A}{2\pi n}\left(2\sin\left(\frac{\pi}{4}n\right) - \sin\left(\frac{5\pi}{4}n\right) + \sin\left(\frac{3\pi}{4}n\right)\right)$$

$$a_n = \frac{A}{\pi n}\left(2\sin\left(\frac{\pi}{4}n\right) - \sin\left(\frac{5\pi}{4}n\right) + \sin\left(\frac{3\pi}{4}n\right)\right)$$

$$a_n \begin{cases} \text{n=odd} \\ 0 \quad \text{o.w} \end{cases}$$

$$x(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos(n\omega_0 t) + \sum_{n=1}^{\infty} b_n \sin(n\omega_0 t)$$ ie

$$x(t) = a_n \cos(n\omega_0 t)$$

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C. Compare between your results obtained in part a and b

```
% abdelrhman abed 119391
T0 = input('Enter the value of T0: ');
A = input('Enter the value of A: ');
t = -15:0.1:15;
f0 = 1/T0;
N = 100;
x = 0;
an = @(n) (A/(n*pi)) * (2*sin(pi*n/4) - sin(5*pi*n/4) + sin(3*pi*n/4));
for n = 1:N
    x = x +an(n) * cos(2*pi*n*f0*t);
end
xl = 0;

for n =-15:15;
          xl_n =  ((-1)^n) * A * rectpuls((t - (n*T0/2)) / (T0/4));

    xl = xl + xl_n;
end
plot(t, x, 'b', 'DisplayName', 'Fourier Series Representation');
hold on;
plot(t, xl, 'r', 'DisplayName', 'Signal');
xlabel('Time (t)');
ylabel('Amplitude');
title('Combined Plots of x(t)');
grid on;
```