Faculty of Engineering & Technology

Electrical & Computer Engineering Department

Signals And Systems ENEE2312

Assignment Report

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Section: 2

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My ID number : 12000549

So:

A=5

B=4

C=9

Question1

Generate and Plot the following signals

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

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

Part A

The code:

Q1AA.m

```
t=-6:0.001:14;
x= rectangularPulse((t-3)/5) + rectangularPulse((t-9)/4);
plot(t,x);
xlabel ('t');
ylabel(' x(t)');
title ('Question 1 part A');
ylim([0 3]);
```

Figure 1: Question1A Code

Plotting:

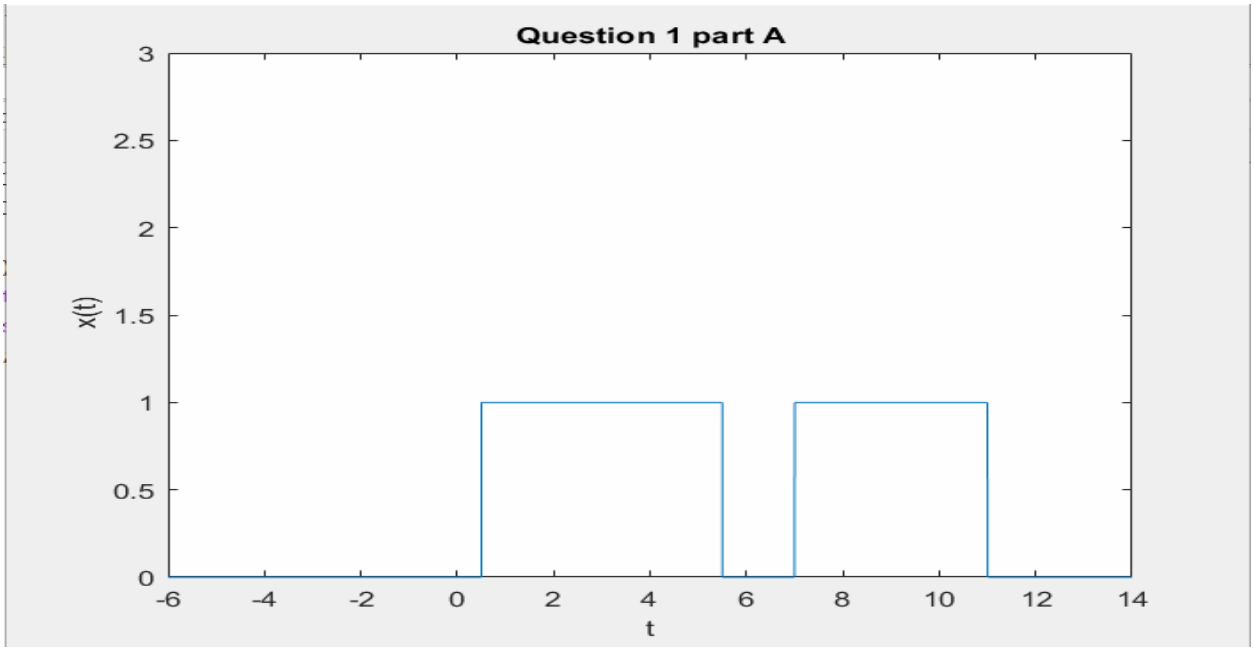

Figure 2: Question1A Plotting

Part B

The Code:

Q1B.m

```
t=-6:0.001:14;
xb=(t.*heaviside(t))-((t-5).*heaviside(t-5))-((t-4).*heaviside(t-4))+((t-9).*heaviside(t-9));
plot(t,xb);
xlabel ('t');
ylabel(' xb(t)');
title ('Question 1 part B');
ylim([0 6]);

```

Figure 3: Question1B Code

Plotting:

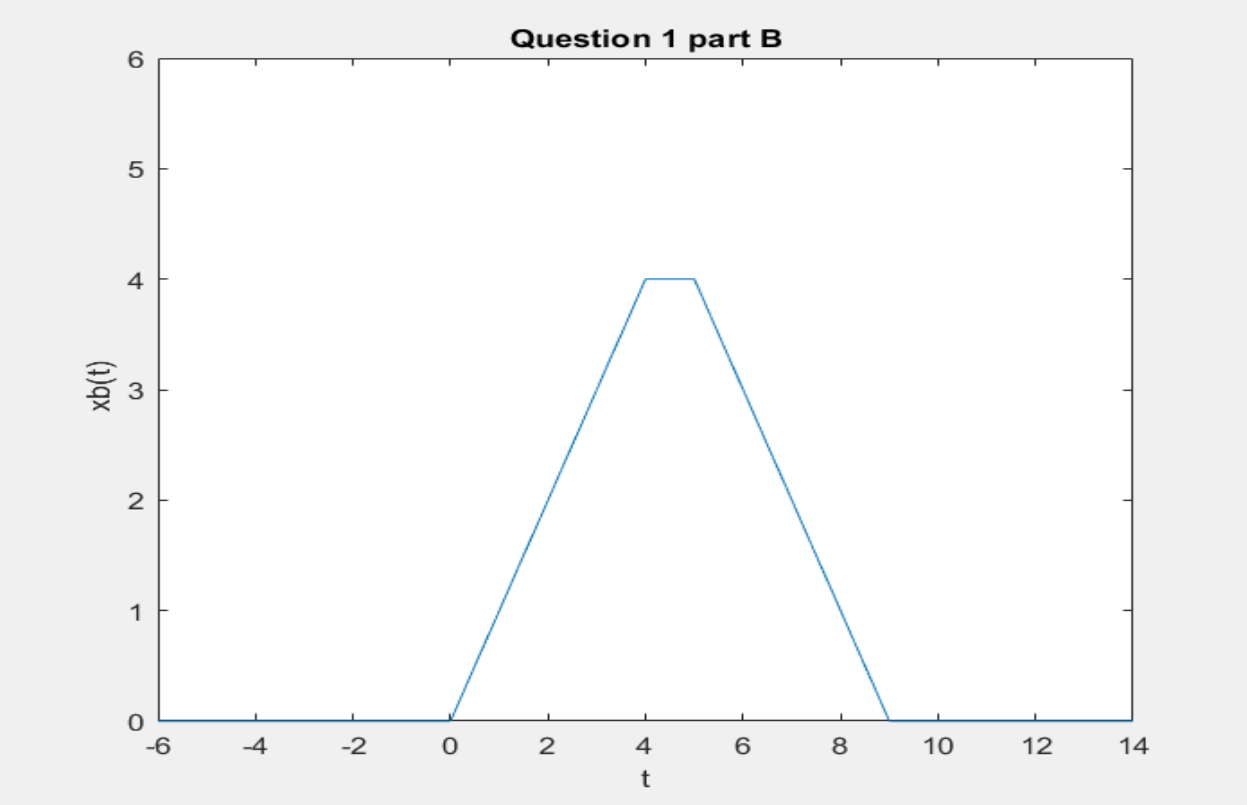

Figure 4: Question1B Plotting

Question2

2. Consider the following signals:

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

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.

I want to plot each part individually, then in part C I will plot them on one figure using subplot.

Part A

First I will find the T0 to find the period, w0=10*pi. So T0= (2*pi)/w0

= (2*pi) / (10*pi)

=0.2

So I take the interval from -0.1 to 0.1 (0.1- - 0.1=0.2)

The Code:

Q2A.m

```
t=-0.1:0.001:0.1;
x1= 5.*sin(10.*pi.*t);
plot(t,x1);
xlabel ('t');
ylabel(' x1(t)');
title ('Question 2 part A');
```

Figure 5: Question2A Code

Plotting:

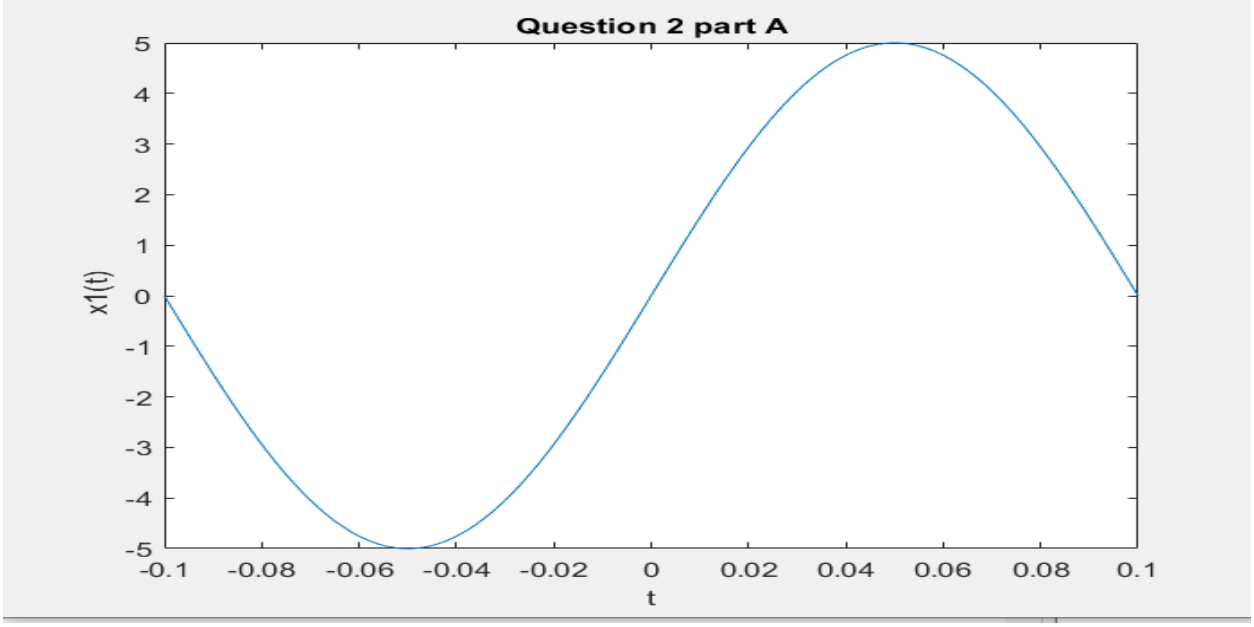

Figure 6: Question2A Plotting

Part B

I also find T0. First I find f0 using GCD (f1, f2)

f1=5

f2=15

GCD(5,15)=5Hz so T0= 0.2. So I take the interval from -0.1 to 0.1 (0.1- - 0.1=0.2)

The Code:

Q2B.m

```
1 -     t=-0.1:0.001:0.1;
2 -     xb= 5.*sin(10.*pi.*t) + ((5/3).*sin(30.*pi.*t));
3 -     plot(t,xb);
4 -     xlabel ('t');
5 -     ylabel(' xb(t)');
6 -     title ('Question 2 part B');
7
```

Figure 7: Question2B Code

Plotting:

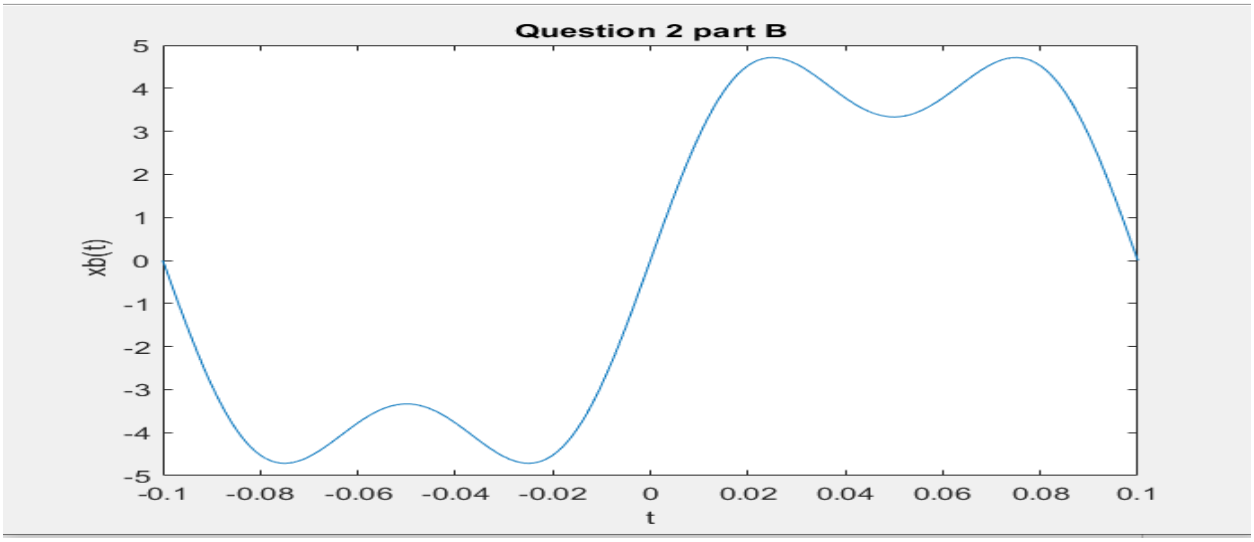

Figure 8: Question2B Plotting

Part C

I also find T0. First I find f0 using GCD (f1, f2, f3)

f1=5

f2=15

f3=25

GCD(5,15,25)=5Hz so T0= 0.2. So I take the interval from -0.1 to 0.1 (0.1- - 0.1=0.2)

The Code:

Q2C.m

```
t=-0.1:0.001:0.1;
xc= 5.*sin(10.*pi.*t) + ((5/3).*sin(30.*pi.*t))+ sin(50.*pi.*t);
plot(t,xc);
xlabel ('t');
ylabel(' xc(t)');
title ('Question 2 part C');

```

Figure 9: Question2C Code

Plotting:

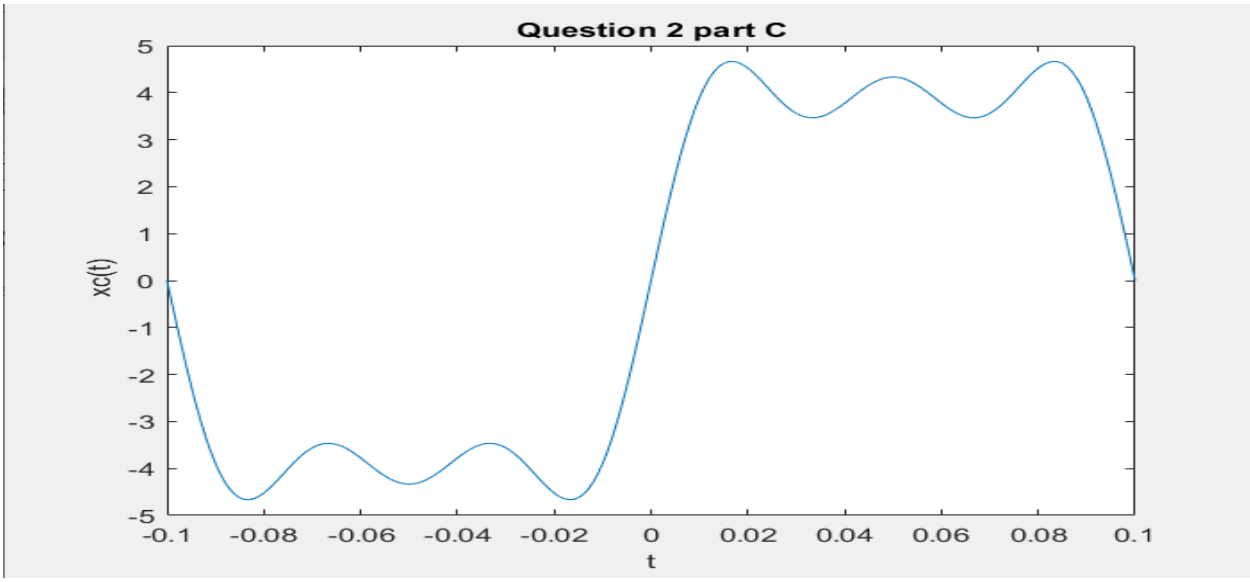

Figure 10: Question2C Plotting

Part A+B+C

Plotting them in one figure using subplot

The Code:

```
Q2CC.m
 1 —     t = -0.1:0.001:0.1;
 2 —     x1 = 5.*sin(10.*pi.*t);
 3 —     x2 = (5/3).* sin(30*pi*t);
 4 —     x3 = sin(50*pi*t);
 5 —     xb = x1+x2 ;
 6 —     xc = x1+x2+x3;
 7 —     subplot(3,1,1);
 8 —     plot(t,x1);
 9 —     title ('Question2 Subplot');
10 —     xlabel ('t');
11 —     ylabel('x1(t)');
12 —     subplot(3,1,2);
13 —     plot(t,xb);
14 —     title ('Question2 Subplot');
15 —     xlabel ('t');
16 —     ylabel('xb(t)');
17 —     subplot(3,1,3);
18 —     plot(t,xc);
19 —     title ('Question2 Subplot');
20 —     xlabel ('t');
21 —     ylabel('xc(t)');
22
```

Figure 11: Question2 Code

Plotting:

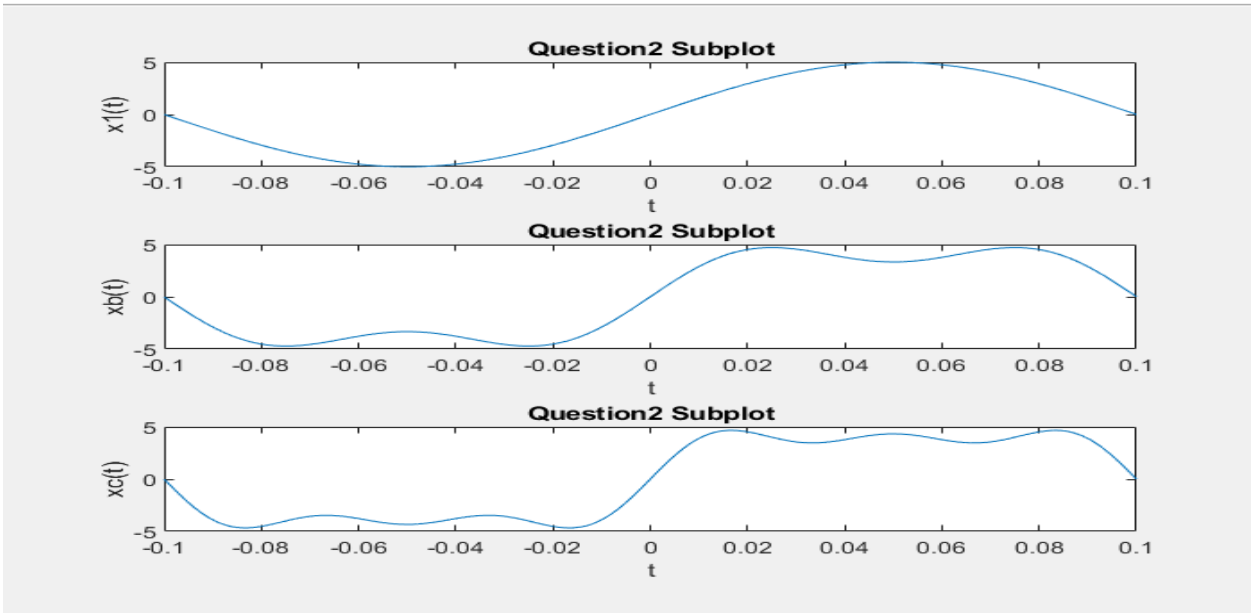

Figure 12: Question2 Plotting

Part D

I take a bigger interval of t to repeat the plotting and we conclude because of that is the signals are periodic. And also we find f0 for these signals which equal 5Hz (rational number), so there are periodic.

The Code:

Q2D.m

```
t = -1:0.001:1;
x1 = 5.*sin(10.*pi.*t);
x2 = (5/3).* sin(30*pi*t);
x3 = sin(50*pi*t);
xb = x1+x2 ;
xc = x1+x2+x3;
subplot(3,1,1);
plot(t,x1);
title ('Question2 Subplot');
xlabel ('t');
ylabel('x1(t)');
subplot(3,1,2);
plot(t,xb);
title ('Question2 Subplot');
xlabel ('t');
ylabel('xb(t)');
subplot(3,1,3);
plot(t,xc);
title ('Question2 Subplot');
xlabel ('t');
ylabel('xc(t)');

```

Figure 13: Question2D Code

Plotting:

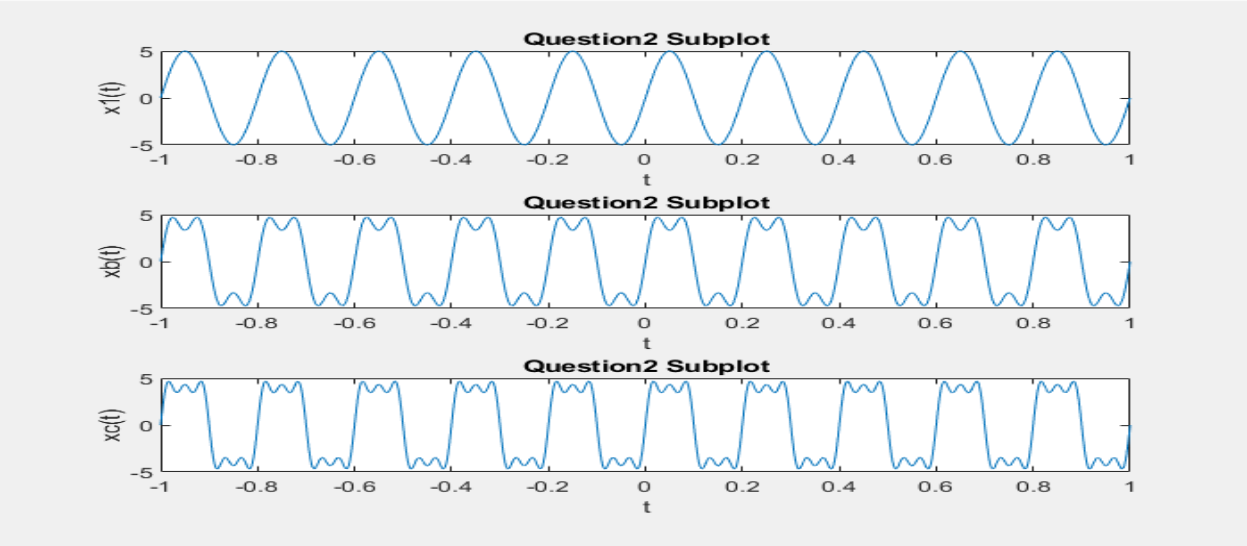

Figure 14: Question2D Code

Question3

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

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

The Code:

```
Q3.m
1 -  syms t toe
2 -  x1=(exp(-2.*toe)-9.*exp(-10.*toe)).*heaviside(toe);
3 -  x2= rectangularPulse((t-toe-4)/5);
4
5 -  convolution_answer=int(x1*x2,toe,-inf,inf);
6 -  fplot(convolution_answer, [-7,17]);
7 -  disp(convolution_answer);
8 -  xlabel ('t');
9 -  ylabel(' x(t)');
10 -  title ('Question 3');
11
12
```

```
Command Window
>> Q3
heaviside(t - 13/2)*((exp(-2*t)*exp(13))/2 - (9*exp(-10*t)*exp(65))/10 + 2/5) - heaviside(t - 3/2)*((exp(-2*t)*exp(3))/2 - (9*exp(-10*t)*exp(15))/10 + 2/5)

fx >>
```

Figure 15: Question3 Code

Convolutiion answer = heaviside(t - 13/2)*((exp(-2*t)*exp(13))/2 - (9*exp(-10*t)*exp(65))/10 + 2/5) - heaviside(t - 3/2)*((exp(-2*t)*exp(3))/2 - (9*exp(-10*t)*exp(15))/10 + 2/5)

Plotting:

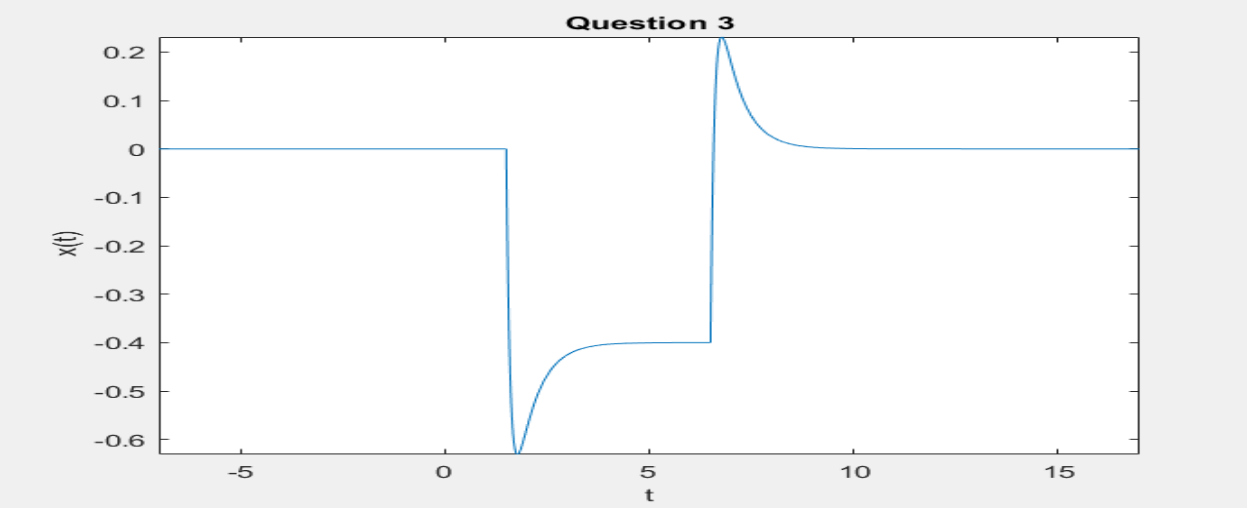

Figure 16: Question3 Plotting

Question4

4. For LTI system $h(t)=Ae^{-Bt}$, consider the input square wave be:

$$x(t)=A+\sum_{\substack{k=-\infty \\ k\ odd}}^{\infty}\frac{B}{\pi k}e^{-j\pi/2}e^{jkt}$$

A. Plot the system frequency response (Amplitude and Phase).
B. Plot the system time response for the square wave input (consider the time interval [0:0.1:7])

Part A

First, I find Hf = 5/(4+1i*2*pi*f)

The code:

Q4AAA.m

```
t=-15:0.1:15;
Htime=(5*exp(-4*t));
Hfrequency=fft(Htime);
Magn=abs(Hfrequency);
Angle=angle(Hfrequency);
figure
plot(Magn);
xlabel('Frequency(Hz)')
ylabel('Magnitude')
title('Magnitude')
figure
plot(Angle);
xlabel('Frequency(Hz)')
ylabel('Phase')
title('Phase spectra')

```

Figure 17: h(f) Code

Plotting:

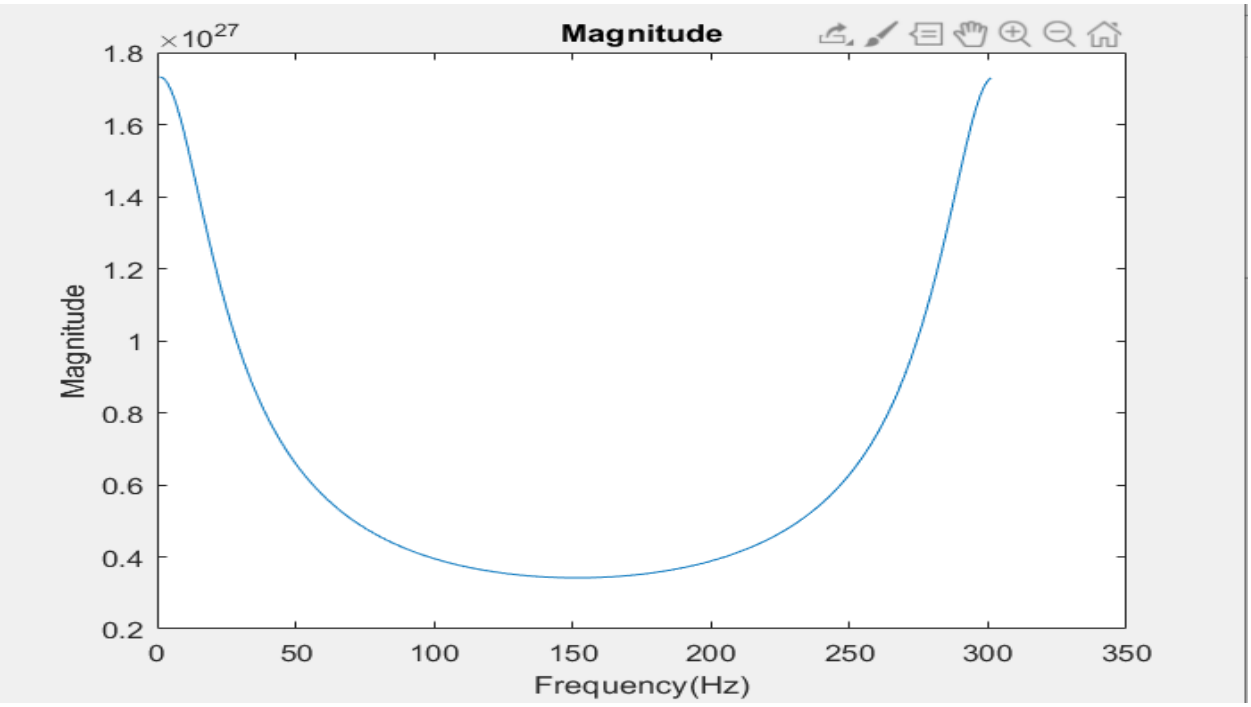

Figure 18: Amplitude of h(f)

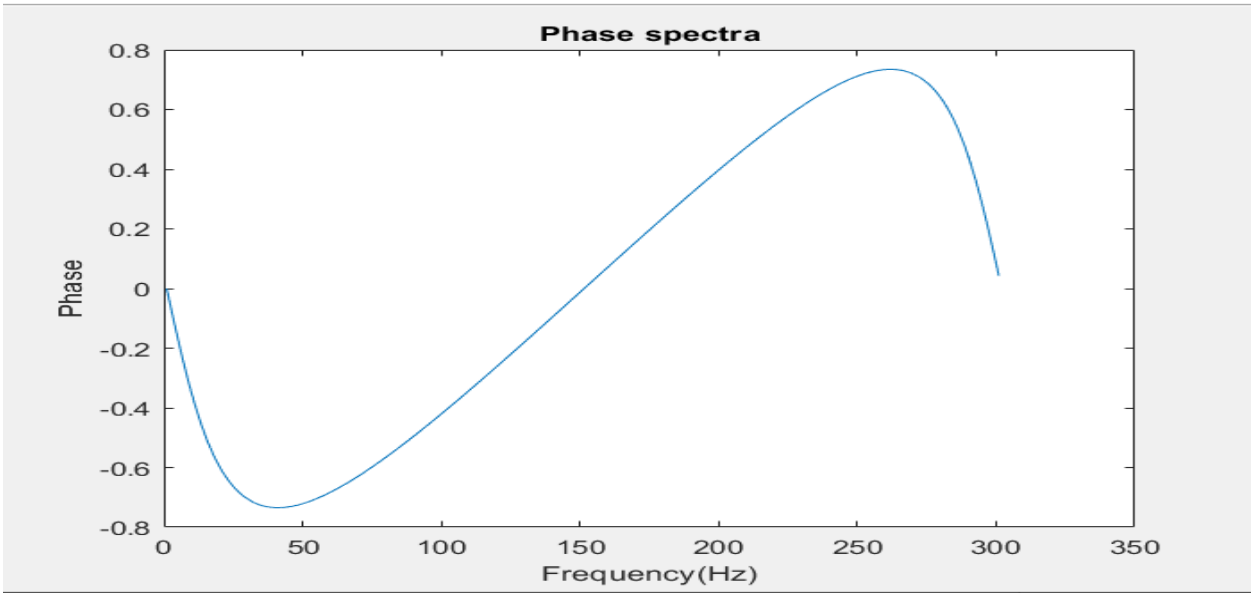

Figure 19: Phase of h(f)

Then, I find y(f)= x(f)*h(f)

The Code:

Q4A1.m

```
t=-15:0.1:15;
sum_k=0;
for k =-80:1:80
 if (mod(k,2)==1)
   x=(4/(pi.*k).*exp((-1i.*pi)/2)).*exp(1i*k*t);
        sum_k=sum_k+x ;
        end
end
sum_k=sum_k+5 ;
 Htime=(5*exp(-4*t));
 XFrequency=fft(sum_k);
 HFrequency=fft(Htime);
 YFrequency= XFrequency.*HFrequency ;
 Magn=abs(YFrequency);
 Angle=angle(YFrequency);
figure
plot(Magn);
xlabel('Frequency(Hz)')
ylabel('Magnitude')
title('Magnitude')
figure
plot(Angle);
xlabel('Frequency(Hz)')
ylabel('Phase')
title('Phase spectra')
```

Figure 20: y(f) Code

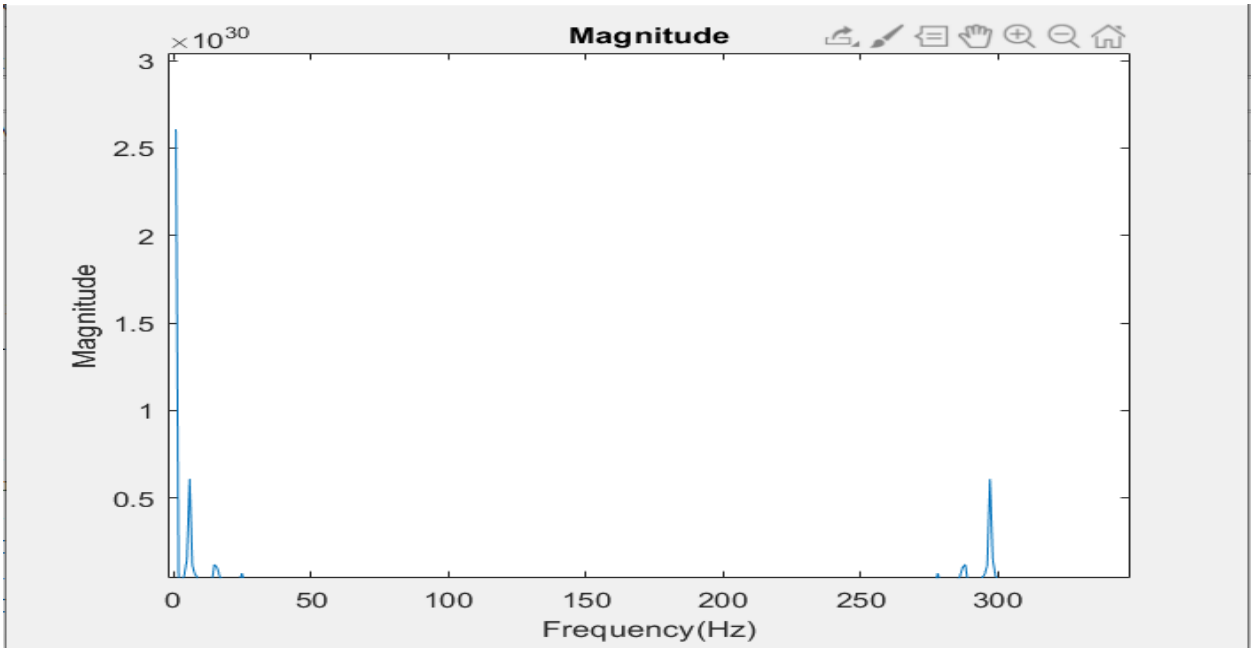

Figure 21: y(f) amplitude

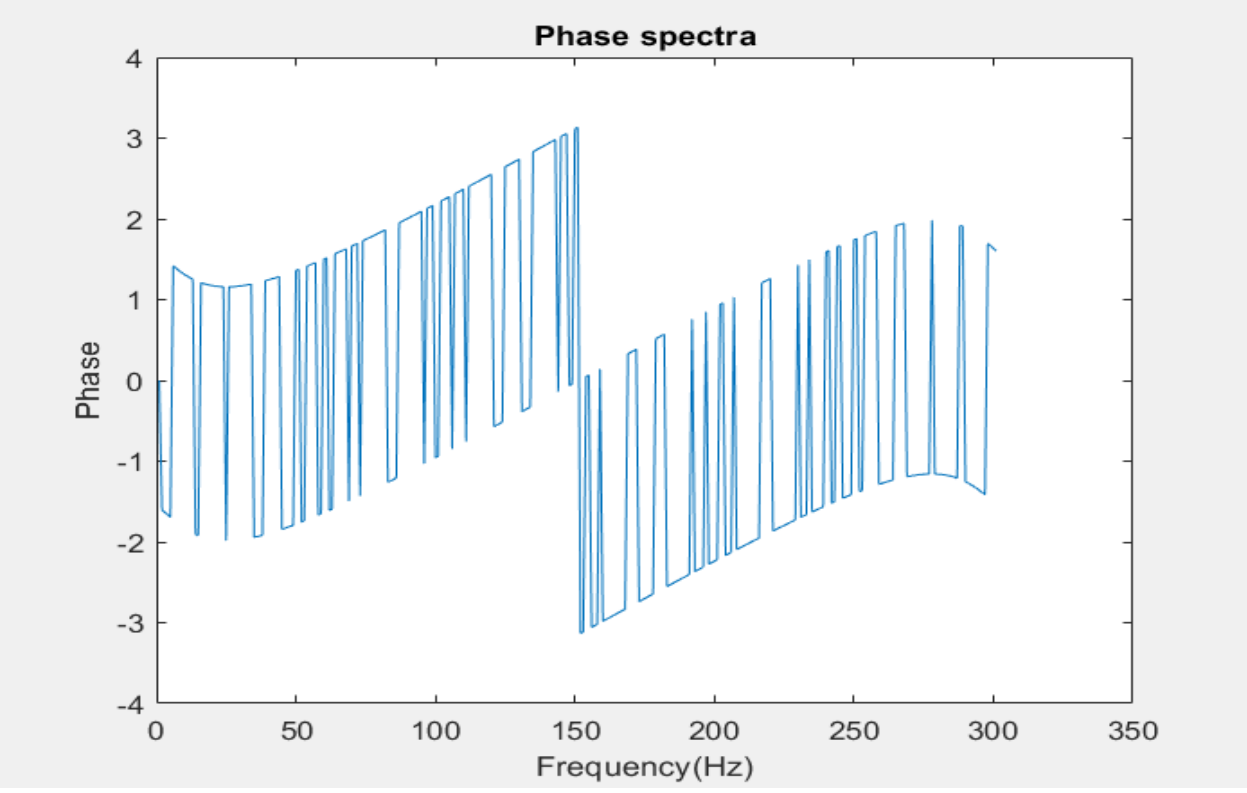

Figure 22: y(f) phase

Part B

I find y(t) and in this section the t is 0:0.1:7.

Q4B.m

```
t=0:0.1:7;
sum_k=0;
for k=-80:1:80
 if (mod(k,2)==1)
   x=(4/(pi.*k).*exp((-1i.*pi)/2)).*exp(1i*k*t);
        sum_k=sum_k+x ;
        end
end
sum_k=sum_k+5 ;
 Htime=(5*exp(-4*t));
 XFrequency=fft(sum_k);
 HFrequency=fft(Htime);
 YFrequency= XFrequency.*HFrequency ;
Ytime= ifft(YFrequency);
figure
mang=abs(Ytime);
plot(t,mang);
xlabel('t')
ylabel('Y(t)')
title('Question4 Part B')

```

Figure 23: Question4B Code

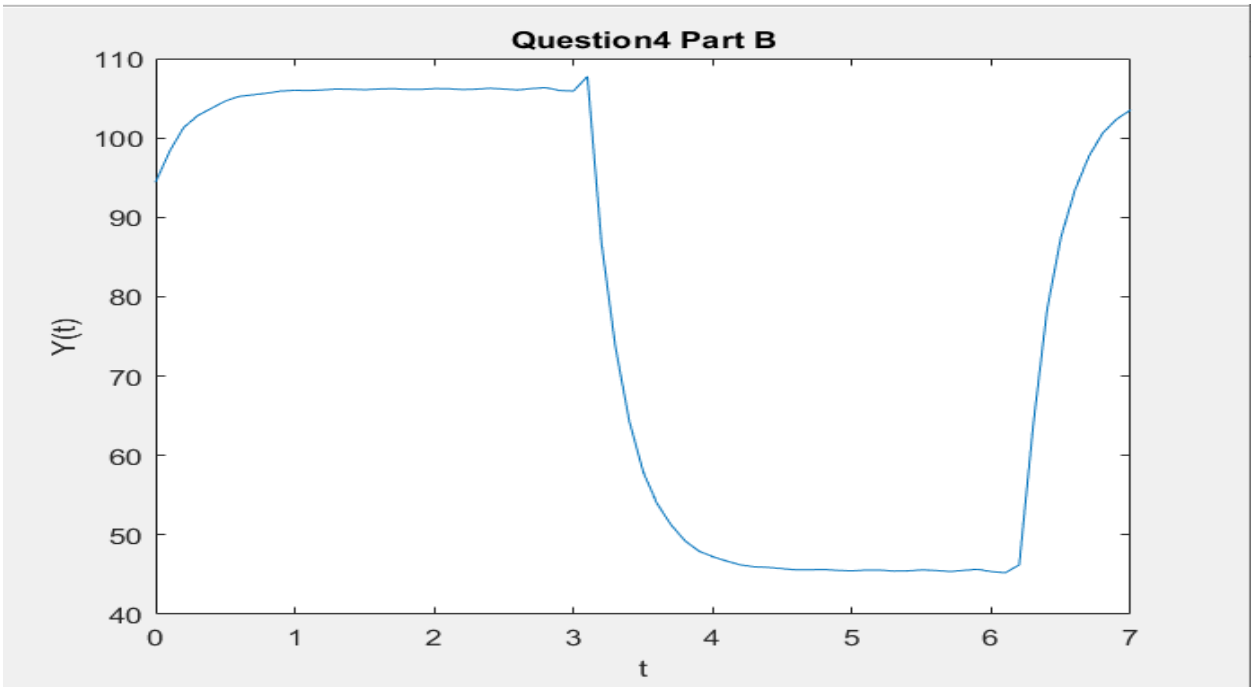

Figure 24: Question4B Plotting