HOMEWORK 1 REPORT

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In this homework, Fourier transform operations of the linear time invariant systems have been practiced. This homework is the repeat of the lecture Signals & Systems EE 331 from previous semester.

In step 2.1.a, function that is defined in the report sheet is created. For loop is used to create the piecewise function. Next step, function that is created at last step is plotted according to the stated parameters. In step 2.1.c, output signal y(t) is created from element-wise multiplication of x(t) and $x_2(t)$. Range of the for loop defines as number of step which is obtained by multiplying sample frequency and whole period. Since MATLAB matrix operations need positive numbers to attach index numbers, range of the empty vectors that is created by linspace() function are from 1 to N+1, which N represents requested number.

```
x2=linspace(1,(fs*T)+1);
for k=1:(fs*T)+1
    x2(k)=cos(4*pi*t(k));
end
```

Figure 1: For loop and linspace operation in step 2.1.c

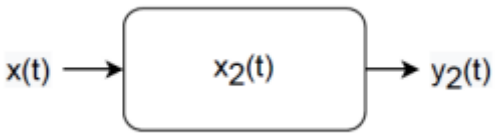

Figure 2: Block diagram of the linear time invariant system in step 2.2

In step 2.2.a, DFT operation is made by using the function from step 2.1. Since convolution of the input signal and impulse response gives output in time domain, multiplication of the Fourier transforms of these signals give Fourier transform of the output signal. In order to plot magnitude of the frequency spectrum of output signal fftshift() and abs() functions.

```
x1f=fftshift(abs(fft(extendedx1,length(extendedx1)))/length(extendedx1));
y1f=fftshift(abs(fft(extendedy1,length(extendedy1)))/length(extendedy1));
f=linspace(-fs/2,fs/2,length(extendedx1));
```

Figure 3: Fourier Transform

Zero padding is applied for reconfiguring the length of the signals before DFT operation to make correct comparation between two output results which one of them is created with conv() function and other one is created step by step in 2.2.b.

```
%% length reconfiguration of x1 and x2
N=length(x1); % length of x1,x2 and y1 are equal %
z_matrix=zeros(1,N-1);
extendedx1= [ x1 z_matrix];
extendedx2= [ x2 z_matrix];
extendedy1= [ y1 z_matrix];
```

Figure 4: Length configuration of the signals

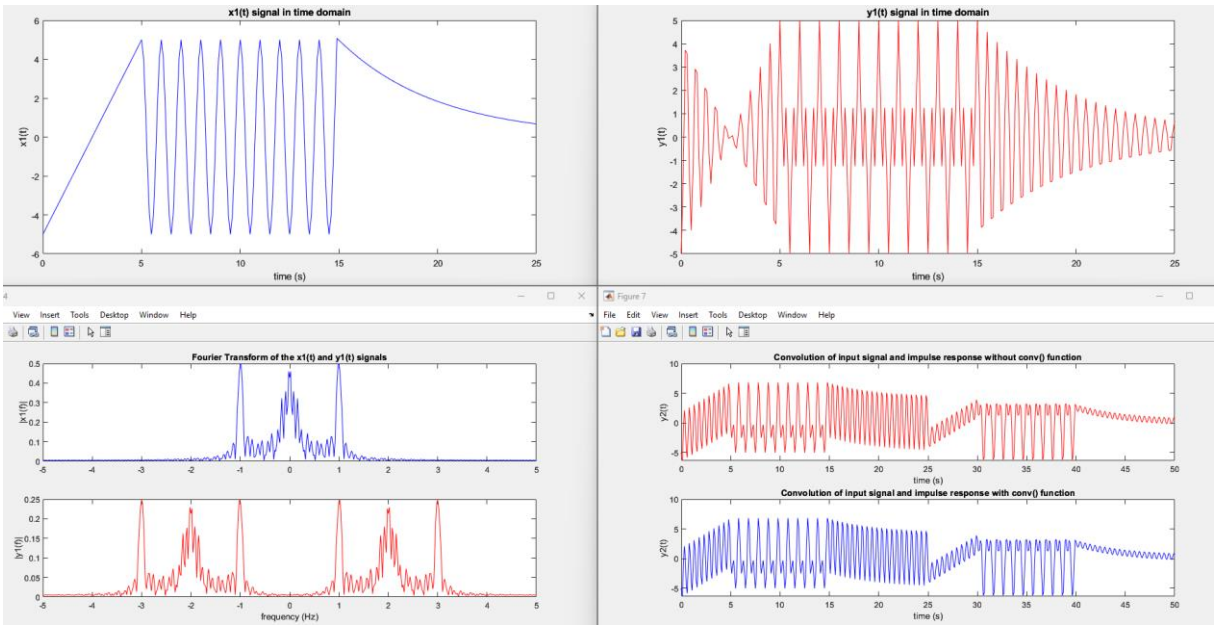

Figure 5: Plotted signals of several steps

To conclude, this homework was useful to remember Fourier transform operations. It is also understood the process of impulse response in linear time invariant signals. Comparation of the two method for obtaining output response helped to understand the inner process of convolution operation.