Lab Assignment - 06 - Spring 2020

Signals and systems
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Q)Based on the definition of continuous time Fourier transform and inverse Fourier transform, write a matlab code for these transforms. Next, for each of the given aperiodic signals, use these matlab codes to

• To compute the Fourier transform and plot the magnitude and phase components of the spectrum versus frequency.

• To compute the inverse Fourier transform and plot and compare with the original signal.

- $x1(t) = \exp(-|t|)(u(t + 2\pi) - u(t - 2\pi))$
- $x2(t) = \text{sinc}(t)(u(t + 2\pi) - u(t - 2\pi))$
- $x3(t) = \exp(1/(1 + |t|))(u(t) - u(t - 2 * \pi))$

Here’s the code for question 1 :

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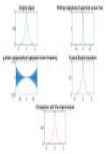
Live Editor - C:\Users\aniru\OneDrive\Documents\MATLAB\assign06_final1.mlx

unit.mlx | assign06_final2.mlx | assign06_final1.mlx | assign06_final3.mlx | assign06_trial3.m | +

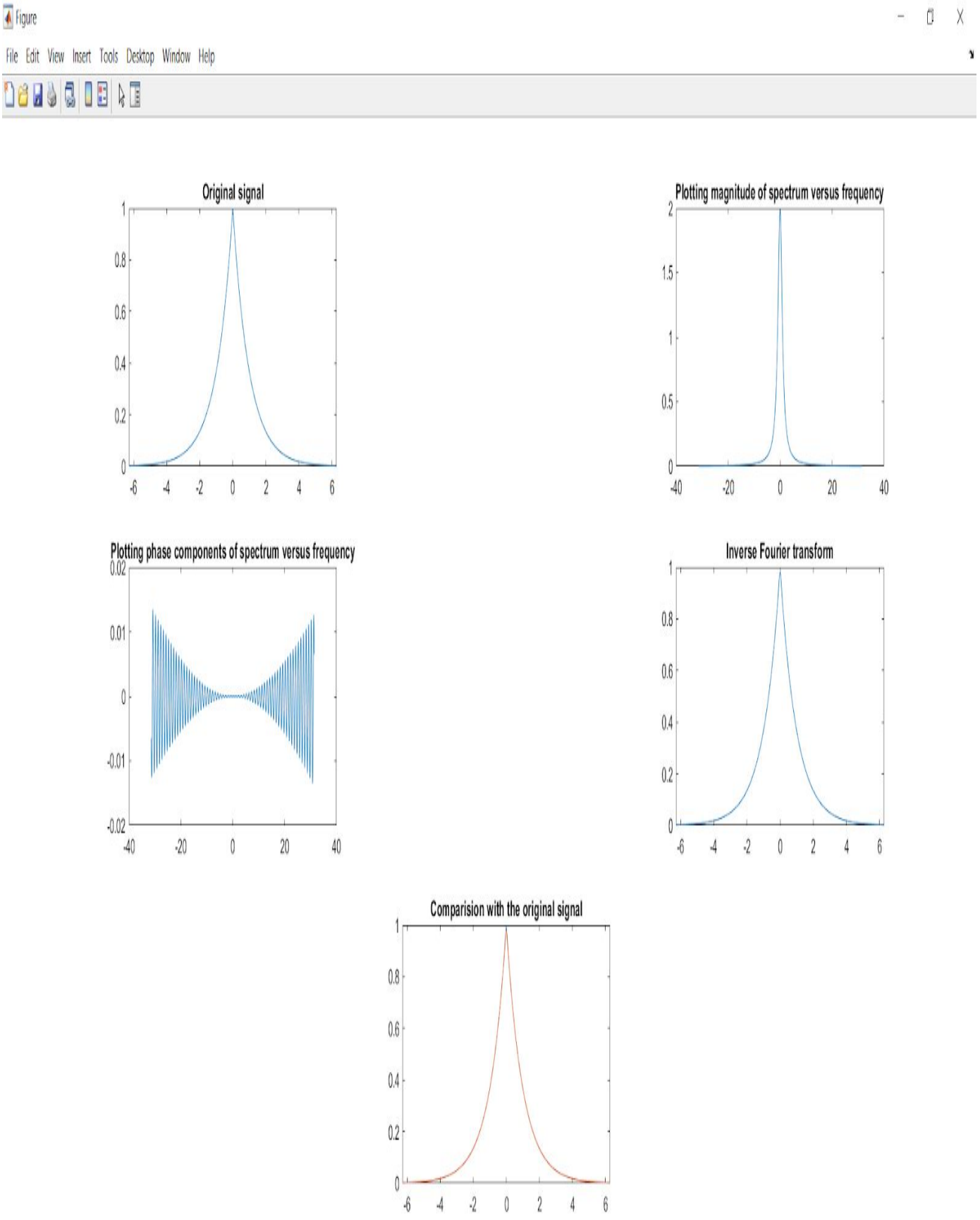
```
clear
clc
w=-10*pi:0.01*pi:10*pi;
t=-2*pi:0.01*pi:2*pi;
% PROBLEM 1
x=exp(-abs(t)).*(unit(t+2*pi)-unit(t-2*pi));
subplot(3,3,1);plot(t,x);title('Original signal');

x_w=zeros(size(w));
for i=1:length(w)
    k=w(i);
    basis1=exp(-1i*k*t);
    x_w(i)=trapz(t,x.*basis1);
end
subplot(3,3,3);plot(w,abs(x_w));
title('Plotting magnitude of spectrum versus frequency');
subplot(3,3,4);plot(w,angle(x_w));
title('Plotting phase components of spectrum versus frequency');

x_t=zeros(size(t));
for i=1:length(t)
    k=t(i);
    basis2=exp(1i*w*k);
    x_t(i)=(1/(2*pi))*trapz(w,x_w.*basis2);
end
subplot(3,3,6);plot(t,real(x_t));title('Inverse Fourier transform');
subplot(3,3,8);plot(t,x);
hold on;
plot(t,real(x_t));title('Comparision with the original signal');
```



Workspace

Name	Value
b	1x601 double
basis1	1x601 complex d...
basis2	1x2001 complex ...
i	601
k	9.4248
t	1x601 double
t1	9.4248
w	1x2001 double
x	1x601 double
x_t	1x601 complex d...
x_w	1x2001 complex ...

Here’s the output for question 1 :



Here’s the code for question 2 :

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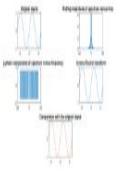
unit.mlx | assign06_final2.mlx | assign06_final1.mlx | assign06_final3.mlx | assign06_trial3.m

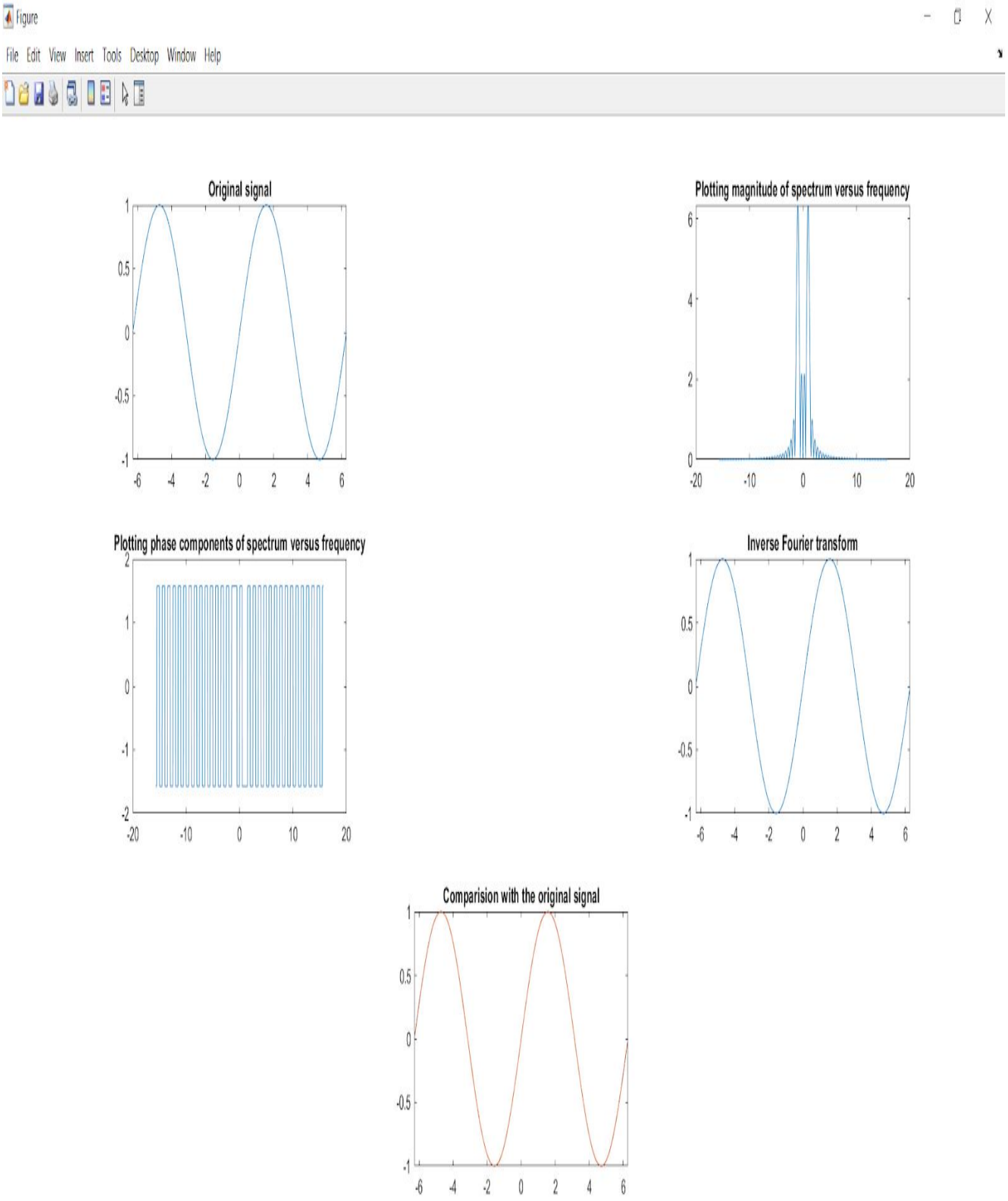
```
clear
clc
w=-5*pi:0.01*pi:5*pi;
t=-2*pi:0.01*pi:2*pi;
% PROBLEM 2
x=sin(t).*(unit(t+2*pi)-unit(t-2*pi));
subplot(3,3,1);plot(t,x);title('Original signal');

x_w=zeros(size(w));
for i=1:length(w)
    k=w(i);
    basis1=exp(-1i*k*t);
    x_w(i)=trapz(t,x.*basis1);
end
subplot(3,3,3);plot(w,abs(x_w));
title('Plotting magnitude of spectrum versus frequency');
subplot(3,3,4);plot(w,angle(x_w));
title('Plotting phase components of spectrum versus frequency');

x_t=zeros(size(t));
for i=1:length(t)
    k=t(i);
    basis2=exp(1i*w*k);
    x_t(i)=(1/(2*pi))*trapz(w,x_w.*basis2);
end
subplot(3,3,6);plot(t,real(x_t));title('Inverse Fourier transform');
subplot(3,3,8);plot(t,x);
hold on;
plot(t,real(x_t));title('Comparision with the original signal');
```



Workspace

Name	Value
basis1	1x401 complex d...
basis2	1x1001 complex ...
i	401
k	6.2832
t	1x401 double
w	1x1001 double
x	1x401 double
x_t	1x401 complex d...
x_w	1x1001 complex ...

Here’s the output for question 2 :



Here’s the code for question 3 :

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unit.mlx | assign06_final2.mlx | assign06_final1.mlx | assign06_final3.mlx * | assign06_trial3.m

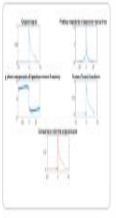
```
% PROBLEM 3
b=zeros(size(t));
for i=1:length(t)
    t1=t(i);
    k=1+abs(t1);
    b(i)=1/k;
end
x=b.*(unit(t)-unit(t-2*pi));
subplot(3,3,1);plot(t,x);title('Original signal');

x_w=zeros(size(w));
for i=1:length(w)
    k=w(i);
    basis1=exp(-1i*k*t);
    x_w(i)=trapz(t,x.*basis1);
end
subplot(3,3,3);plot(w,abs(x_w));
title('Plotting magnitude of spectrum versus frequency');
subplot(3,3,4);plot(w,angle(x_w));
title('Plotting phase components of spectrum versus frequency');

x_t=zeros(size(t));
for i=1:length(t)
    k=t(i);
    basis2=exp(1i*w*k);
    x_t(i)=(1/(2*pi))*trapz(w,x_w.*basis2);
end
subplot(3,3,6);plot(t,real(x_t));title('Inverse Fourier transform');
subplot(3,3,8);plot(t,x);
hold on;
plot(t,real(x_t));title('Comparision with the original signal');
```

Workspace

Name	Value
b	1x601 double
basis1	1x601 complex d...
basis2	1x2001 complex ...
i	601
k	9.4248
t	1x601 double
t1	9.4248
w	1x2001 double
x	1x601 double
x_t	1x601 complex d...
x_w	1x2001 complex ...



Here’s the output for question 3 :

Figure

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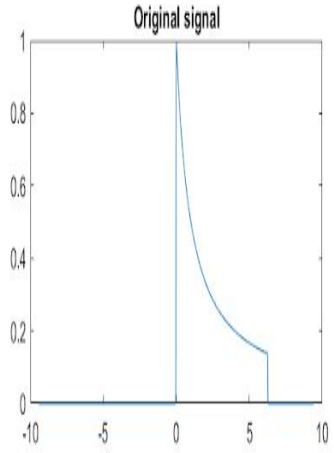

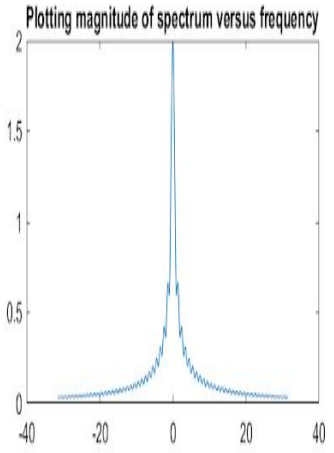

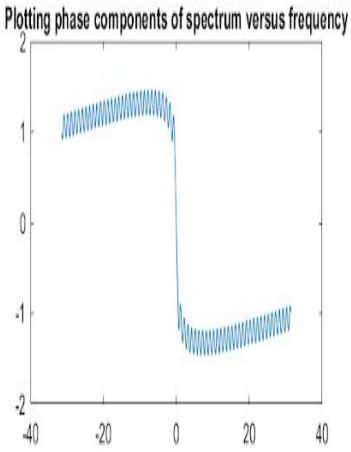

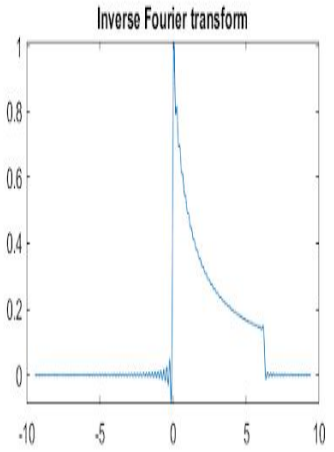

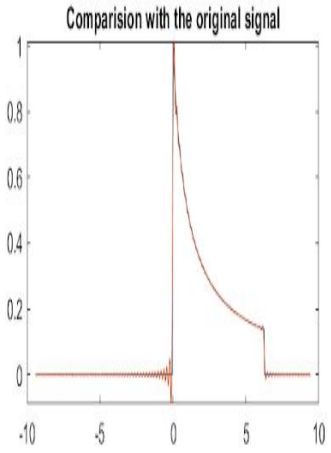

Observation :

- Firstly, we wrote the code for plotting the respective signals and then we have computed the fourier transform of each respective signal.
- Then, we have reconstructed the signal using the inverse fourier transform and plotted it respectively for each signal.
- We also compared the original signal with our inverse fourier transform of each signal and plotted it respectively for each signal.
- Thus, we observed that the two signals overlap each other.

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