# MATLAB-6

## 1 Fourier Transforms

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

- Compute the Fourier transform and plot the magnitude and phase components of the spectrum versus frequency
- Compute the inverse Fourier transform and plot and compare with the original signal

$$x_1(t) = exp(-|t|)\big(u(t+2\pi) - u(t-2\pi)\big)$$

```
clear;clc;
w=-4*pi:0.01:4*pi;
t=w;
p=t;
x1 = zeros(size(t));
x1 = exp(-abs(t)).*(u(t+2*pi)-u(t-2*pi));
a = zeros(size(t));
b = zeros(size(t));
d = zeros(size(t));
for i=1:length(p)
  k=p(i);
   basis=exp(-1i*k*t);
```

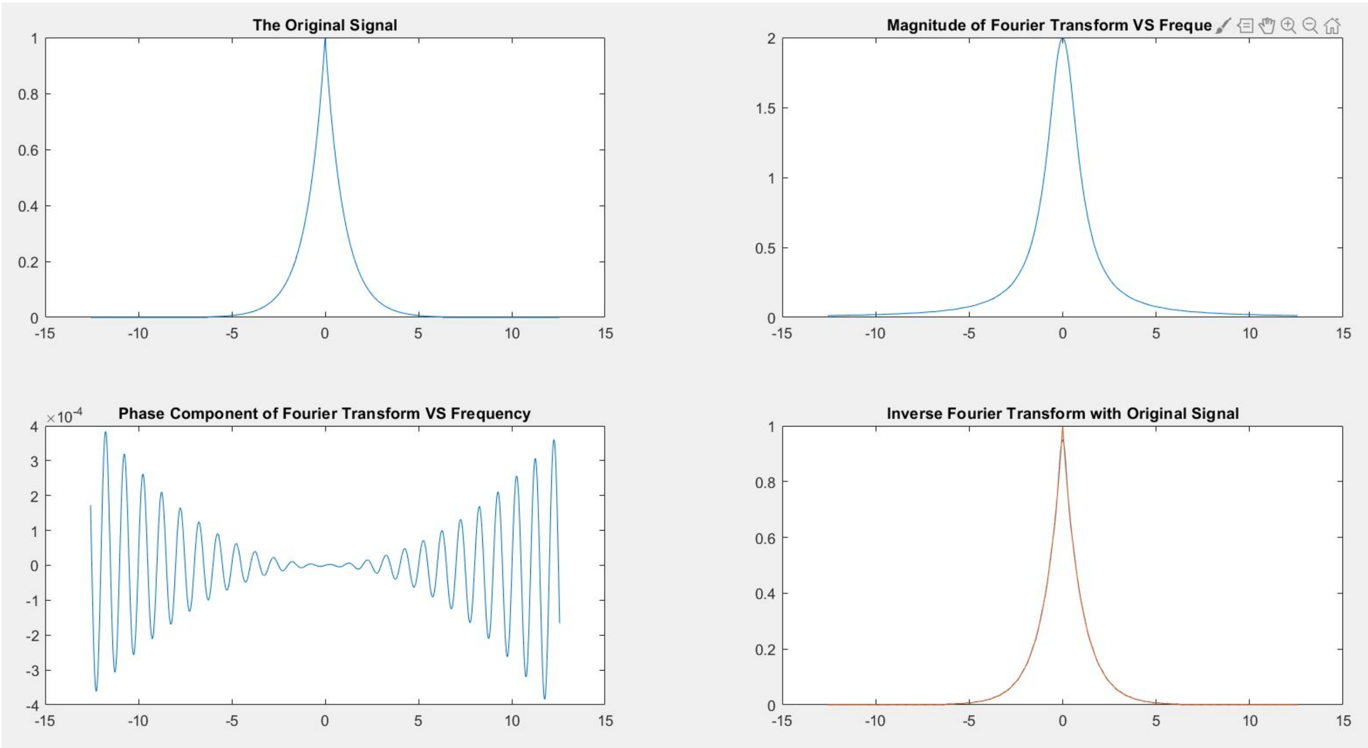
```
    a(i)=trapz(p,x1.*basis);
end
for j=1:length(w)
    xt = w(j);
    inv =exp(1i*w*xt);
    d(j)=1/2/pi*trapz(w,a.*inv);
end

subplot(221);
plot(t,x1);
title('The Original Signal');
subplot(222);
plot(w,abs(a));
title('Magnitude of Fourier Transform VS Frequency');

subplot(223);
plot(w,angle(a));
title('Phase Component of Fourier Transform VS Frequency');
subplot(224);
plot(w,d);
hold on;
plot(t,x1);
title('Inverse Fourier Transform with Original Signal');




function x1 = u(t)
x1 = zeros(size(t));
x1(t>=0)=1;
end
```




$$x_2(t) \quad = \quad sinc(t)\big(u(t+2\pi) - u(t-2\pi)\big)$$

```
clear;clc;
w=-4*pi:0.01:4*pi;
t=-4*pi:0.01:4*pi;
p=t;
x2 = zeros(size(t));
x2 = sinc(t).*(u(t+2*pi)-u(t-2*pi));

a = zeros(size(t));
b = zeros(size(t));
d = zeros(size(t));
for i=1:length(p)
   k=p(i);
    basis=exp(-1i*k*t);
    a(i)=trapz(p,x2.*basis);
end
```

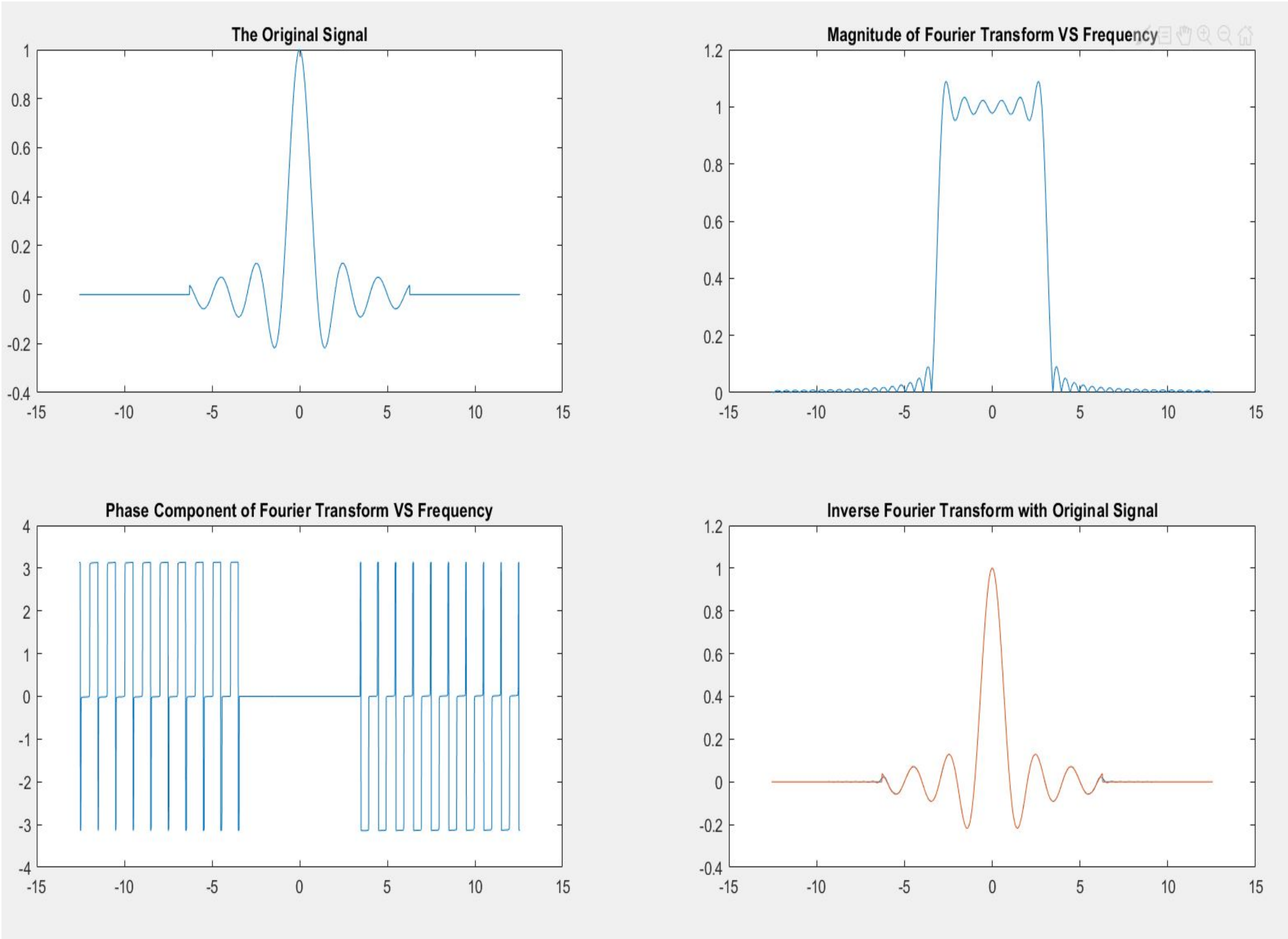
```
for j=1:length(w)
    xt = w(j);
    inv =exp(1i*w*xt);
    d(j)=1/2/pi*trapz(w,a.*inv);
end

subplot(221);
plot(t,x2);
title('The Original Signal');

subplot(222);
plot(w,abs(a));
title('Magnitude of Fourier Transform VS Frequency');
subplot(223);
plot(w,angle(a));
title('Phase Component of Fourier Transform VS Frequency');
subplot(224);
plot(w,d);
hold on;
plot(t,x2);
title('Inverse Fourier Transform with Original Signal');



function x1 = u(t)
x1 = zeros(size(t));
x1(t>=0)=1;
end
```




$$x_3(t) \quad = \quad exp\left(\frac{1}{1+|t|}\right)\left(u(t)-u(t-2*\pi)\right)$$

```
clear;clc;
w=-4*pi:0.01:4*pi;
t=w;
p=t;
x3 = zeros(size(t));

x3 = exp(1./(1+abs(t))).*(u(t)-u(t-2*pi));
```

```
a = zeros(size(t));
b = zeros(size(t));
d = zeros(size(t));
for i=1:length(p)
  k=p(i);
   basis=exp(-1i*k*t);
   a(i)=trapz(p,x3.*basis);
end
for j=1:length(w)
   xt = w(j);

   inv =exp(1i*w*xt);

   d(j)=1/2/pi*trapz(w,a.*inv);
end

subplot(221);
plot(t,x3);
title('The Original Signal');
subplot(222);
plot(w,abs(a));
title('Magnitude of Fourier Transform VS Frequency');

subplot(223);
plot(w,angle(a));
title('Phase Component of Fourier Transform VS Frequency');

subplot(224);
plot(w,d);
hold on;
plot(t,x3);
title('Inverse Fourier Transform with Original Signal');
```

```
function x1 = u(t)
x1 = zeros(size(t));
x1(t>=0)=1;
end
```