

Chittagong University of Engineering and Technology

Department of Electrical and Electronic Engineering

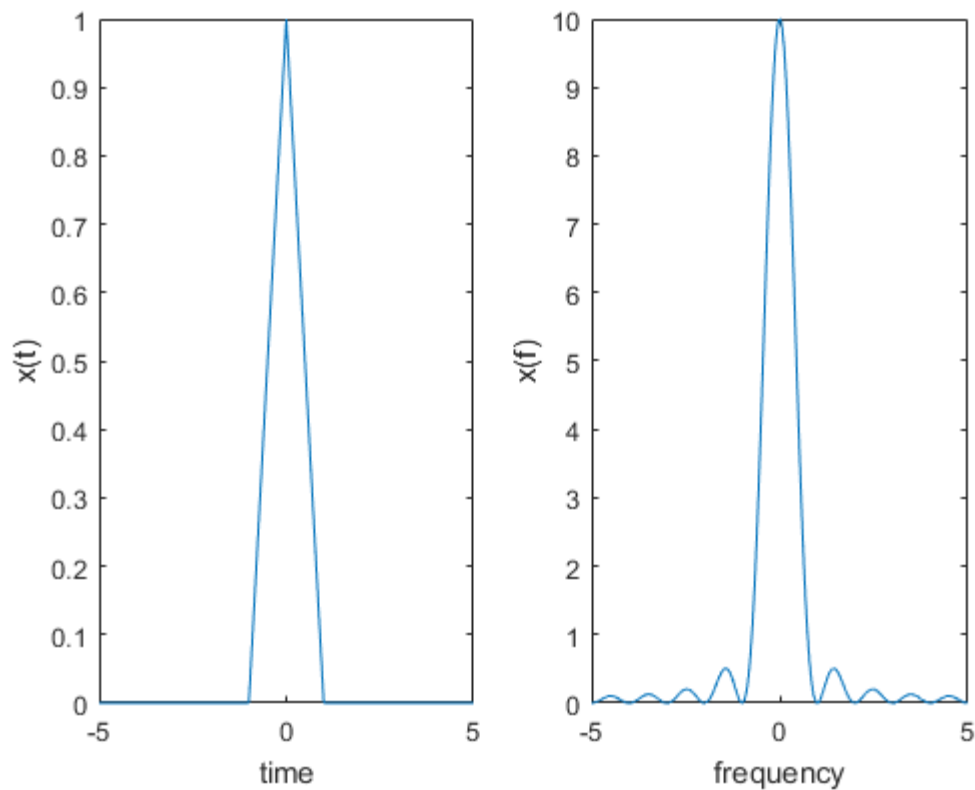
Course No : EEE-496
Course Title : Digital Signal Processing Sessional
Experiment No : 02
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Problem-01: Illustrate the spectral leakage phenomenon using MATLAB.

```
clc;
close all;
Fs=10
t=-5:1/Fs:5
x=triangularPulse(-1, 0, 1, t)
subplot(121)
plot(t,x)
ylabel('x(t)')
xlabel('time')

NFFT=1000
Fx=fftshift(fft(x,NFFT))
ff=(-.5:1/NFFT:.5-1/NFFT)*Fs
subplot(122)
plot(ff,abs(Fx))
ylabel('x(f)')
xlabel('frequency')
```



Problem-02: Illustrate the aliasing phenomenon using MATLAB.

```
clc
close all

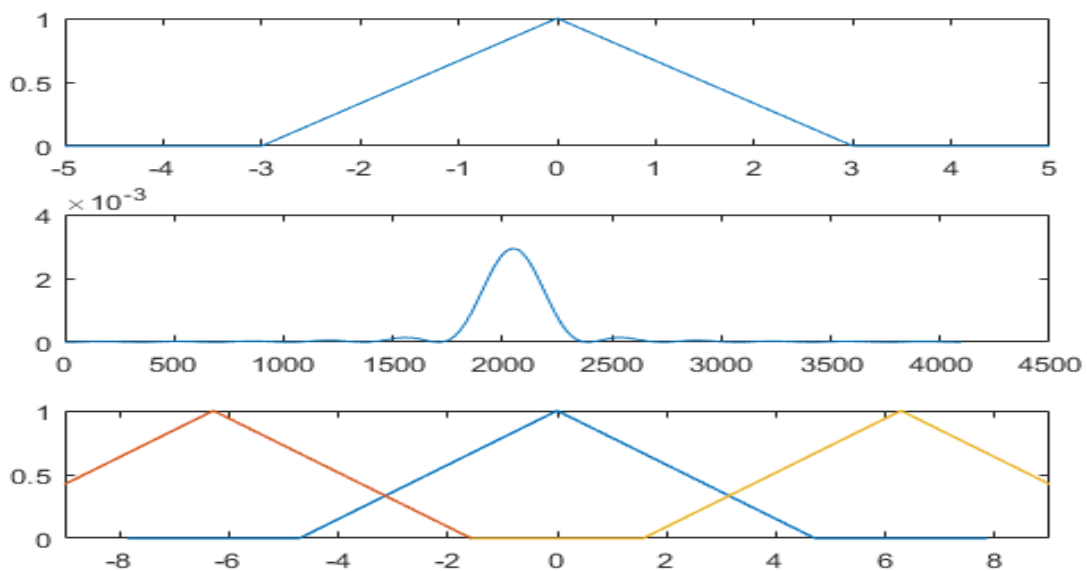
Fs = 4;
F=-5:1/Fs:5;
Xw=triangularPulse(-3, 0, 3, F);

NFFT = 4096;
ff = (-0.5: 1/NFFT: 0.5-1/NFFT)*Fs;
MAG_X2 = ifftshift(abs(ifft(Xw,NFFT)));

figure
subplot(311), plot(F, Xw);

subplot(312), plot(MAG_X2, 'Marker', 'None');

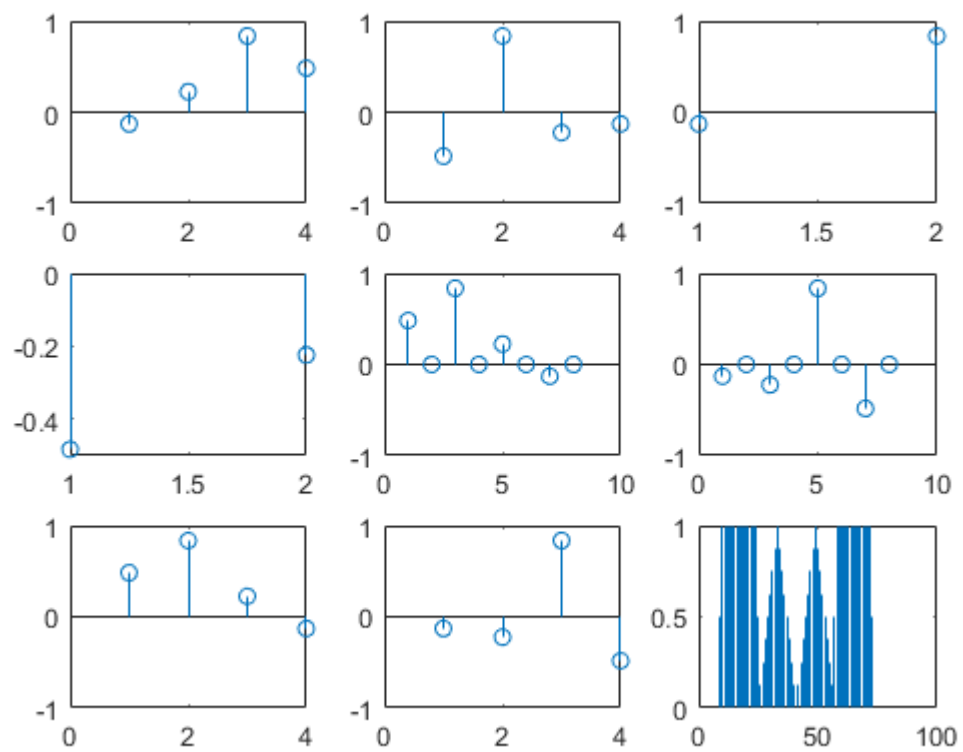
for i = 0:1:2
    A = -5:1/Fs:5;
    if rem(i,2)==0
        delay = (i/2)*((( -1)^i)*2*pi);
    else
        delay = i*((( -1)^i)*2*pi);
    end
    F = (A/Fs)*2*pi;
    subplot(313), plot(F+delay,Xw, 'Linewidth',1);
    xlim([-9 9]);
    hold on;
end
```



Problem-03: Wavelet analysis.

```
clc;
close all;
Fs=8
n=-5:1/8:5
x= heaviside(n+4)-heaviside(n+2)+triangularPulse(-2, -1, 0, n).....
    +triangularPulse(0, 1, 2, n)+ heaviside(n-2)-heaviside(n-4)

[gtilde,htilde,g,h] = wfilters('db2');
v0= downsample(gtilde,2)
v1= downsample(htilde,2)
w0= upsample(g,2)
w1= upsample(h,2)
[lowpass,highpass] = dwt(x,gtilde,htilde);
xrec = idwt(lowpass,highpass,g,h);
subplot(3,3,1),stem(gtilde)
subplot(3,3,2),stem(htilde)
subplot(3,3,3),stem(v0)
subplot(3,3,4),stem(v1)
subplot(3,3,5),stem(w0)
subplot(3,3,6),stem(w1)
subplot(3,3,7),stem(g)
subplot(3,3,8),stem(h)
subplot(3,3,9),stem(xrec,'marker','none')
```



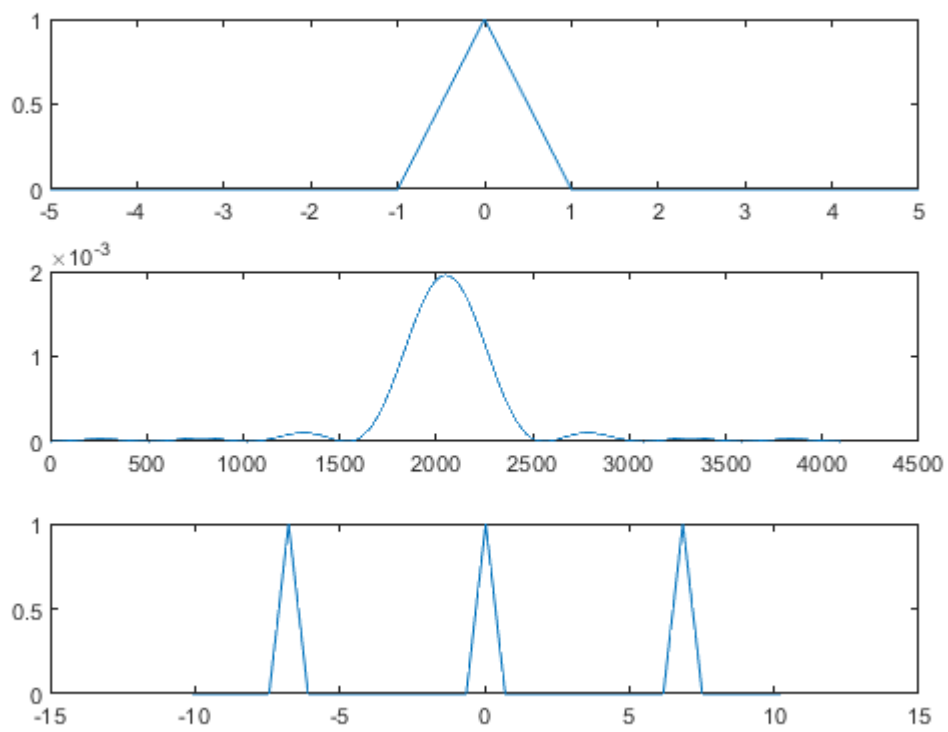
Problem-4.1:

```
clc;
clear all;
close all;

Fs = 8;
F=-5:1/Fs:5;
X_w=triangularPulse(-1, 0, 1, F);
C = zeros(1,3*length(X_w));
p = 0;
NFFT = 4096;
ff = (-0.5: 1/NFFT: 0.5-1/NFFT)*Fs;
MAG_X2 = ifftshift(abs(ifft(X_w,NFFT)));

figure;
subplot(311), plot(F, X_w);
subplot(312), plot(MAG_X2, 'Linewidth',1);

for i = 1:1:3
    for j = 1:length(X_w)
        C(j+p*length(X_w)) = X_w(j);
    end
    p = p+1;
end
A = max(F)/Fs *2*pi + 2*pi;
D = -A:2*A/243:A-(20.42/243);
subplot(313), plot(D+(20.42/243),C);
```



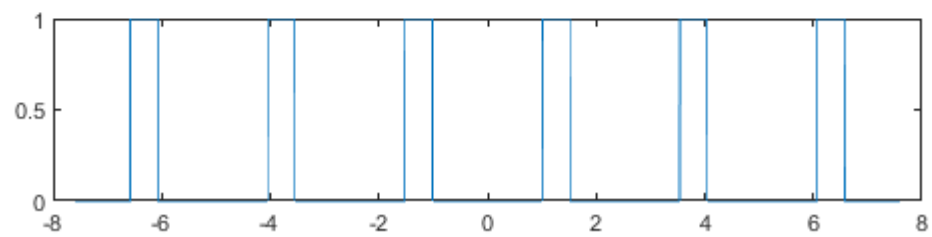
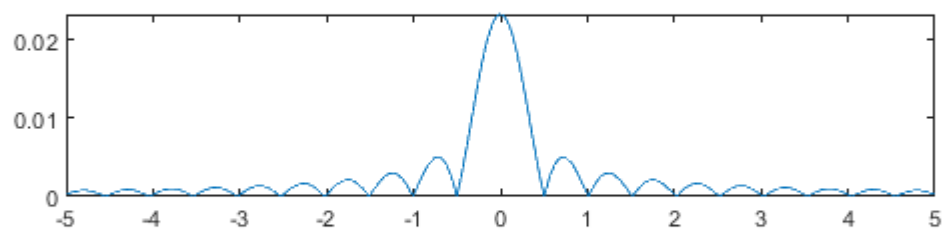
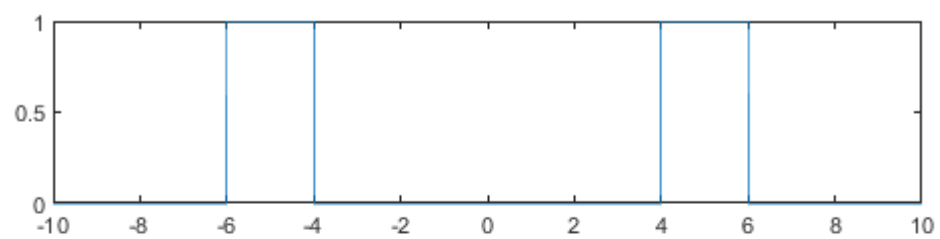
Problem-4.2:

```
clc;
clear all;
close all;
Fs = 48;
N = -10:0.001:10;
ustepp = zeros(size(N));
y = zeros(size(N));
for i = 1: length(N)
    n = N(i);
    y(i) = u_step(n-4)-u_step(n-6);
end
B = y + flip1r(y);
NFFT = 4096;
C = zeros(1,3*length(B));
p = 0;
ff = (-0.5: 1/NFFT: 0.5-1/NFFT)*Fs;
MAG_X2 = ifftshift(abs(ifft(B,NFFT)));

figure;
subplot(311), plot(N,B);
subplot(312), plot(ff,MAG_X2,'Linewidth',1);xlim([-5 5]);
for i = 1:1:3

    for j = 1:length(B)
        C(j+p*length(B)) = B(j);
    end
    p = p+1;
end
A = max(N)/Fs *2*pi + 2*pi;
D = -A:2*A/(3*length(B)):A-2*A/(3*length(B));
subplot(313), plot(D+2*A/(3*length(B)),C);

function y = u_step(t)
if t<0
    y=0;
else
    y=1;
end
end
```

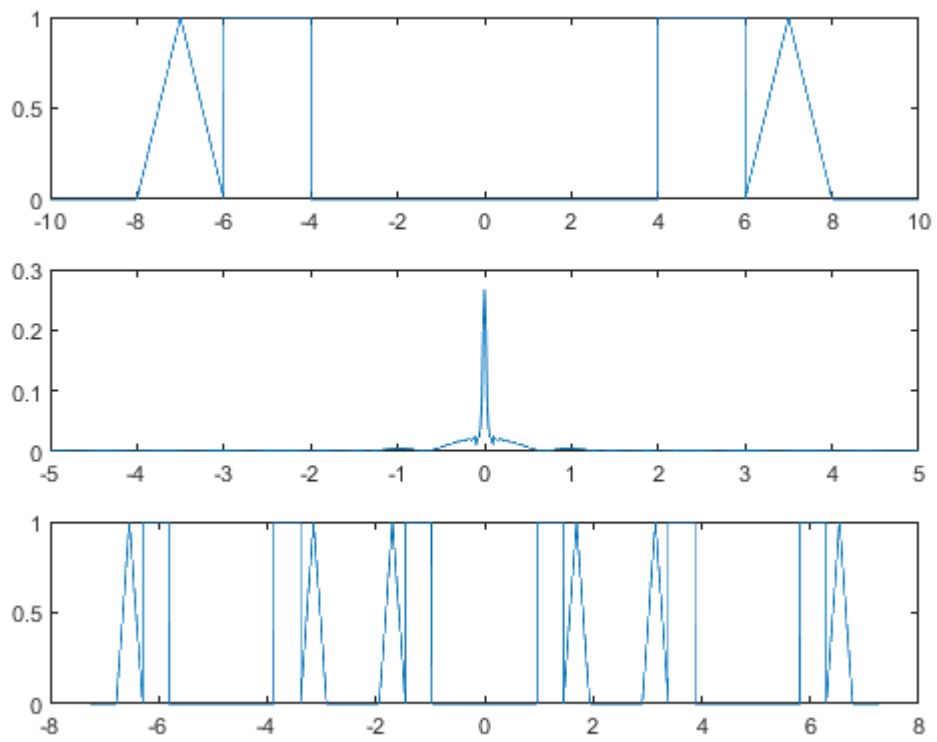



Problem 4.3:

```
clc
clear
close all
Fs = 64;
F=-5:1/Fs:5;
N = -10:0.001:10;
ustepp = zeros(size(N));
y = zeros(size(N));
for i = 1: length(N)
    n = N(i);
    y(i) = u_step(n-4)-u_step(n-6)+ u_ramp(n-6)-2*u_ramp(n-7)+u_ramp(n-8);
end
B = y + flip1r(y);
NFFT = 4096;
C = zeros(1,3*length(B));
p = 0;
ff = (-0.5: 1/NFFT: 0.5-1/NFFT)*Fs;
MAG_X2 = ifftshift(abs(ifft(B,NFFT)));

figure
subplot(311), plot(N,B)
subplot(312),plot(ff,MAG_X2,'Linewidth',1);xlim([-5 5])
for i = 1:1:3

    for j = 1:length(B)
        C(j+p*length(B)) = B(j);
    end
    p = p+1;
end
A = max(N)/Fs *2*pi + 2*pi;
D = -A:2*A/(3*length(B)):A-2*A/(3*length(B));
subplot(313),plot(D+2*A/(3*length(B)),C);
function y = u_step(t)
if t<0
    y=0;
else
    y=1;
end
end
function z = u_ramp(t)
if t>0
    z=t;
else
    z=0;
end
end
```



Problem 4.4:

```
clc;
clear all;
close all;
Fs = 32;
F=-5:1/Fs:5;
n=-5:0.01:5;
B= heaviside(n+4)-heaviside(n+2)+triangularPulse(-2, -1, 0, n)...
    +triangularPulse(0, 1, 2, n)+ heaviside(n-2)-heaviside(n-4);
NFFT = 4096;
C = zeros(1,3*length(B));
p = 0;
ff = (-0.5: 1/NFFT: 0.5-1/NFFT)*Fs;
MAG_X2 = ifftshift(abs(ifft(B,NFFT)));

figure;
subplot(311), plot(n,B);
subplot(312),plot(ff,MAG_X2,'Linewidth',1);xlim([-5 5]);
for i = 1:1:3

    for j = 1:length(B)
        C(j+p*length(B)) = B(j);
    end
    p = p+1;
end
A = max(n)/Fs *2*pi + 2*pi;
D = -A:2*A/(3*length(B)):A-2*A/(3*length(B));
subplot(313),plot(D+2*A/(3*length(B)),C);
```

