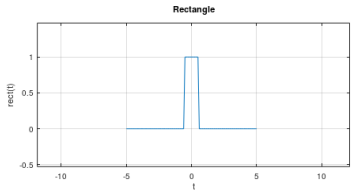
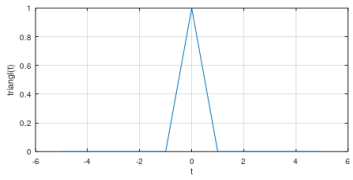
Signals Project Report

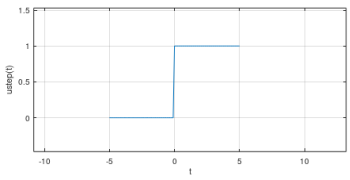
- Part A:
  - Source Code

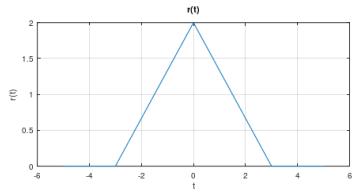
```
limit = 5;

t = -limit:0.1:limit;

ft = rect(t);

subplot(3,3,1), plot(t, ft); #Drawing the rectangle (without the vertical lines)

xlabel("t"); ylabel("rect(t)"); title("Rectangle");


ft = triangl(t);

subplot(3,3,2), plot(t, ft);  #Drawing the triangle

xlabel("t"); ylabel("triangl(t)"); title("Triangle");


ft = ustep(t);

subplot(3,3,3), plot(t, ft);  #Drawing the ustep function, starting from -5 to 5

xlabel("t"); ylabel("ustep(t)"); title("U step");


ft = r(t, 3, 2);

subplot(3,3,4), plot(t,ft); #Drawing the triangle with base [-3,3] & height = 2

xlabel("t"); ylabel("r(t)"); title("r(t)");


t = -4:0.1:3;

ft =  exp(-3.*t) .* sin(8.*pi.*t./5) .* ustep(t+2);

subplot(3,3,5), plot(t, ft); #Drawing the function

xlabel("t"); ylabel("f(t)"); title("f(t)");
```

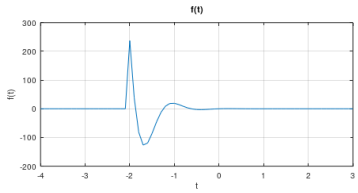
- Figures











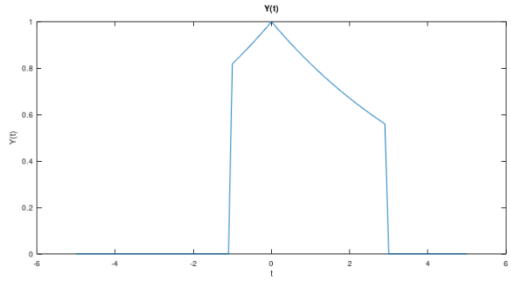
- Part B
  - Source Code
    - "Yt.m"

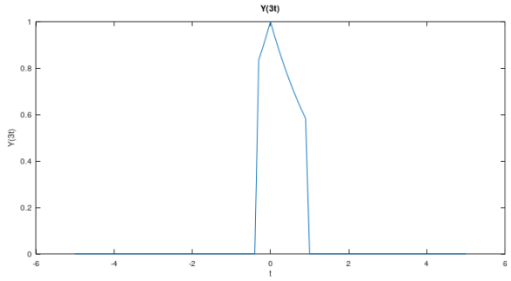
```
function  y=Yt(t)
        y = exp(-1 .* abs(t) ./ 5) .* (ustep(t+1) - ustep(t-3));
endfunction
```

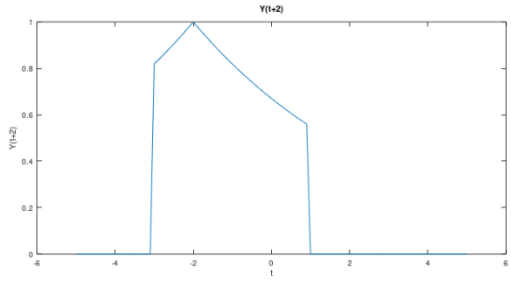
    - "partB.m"

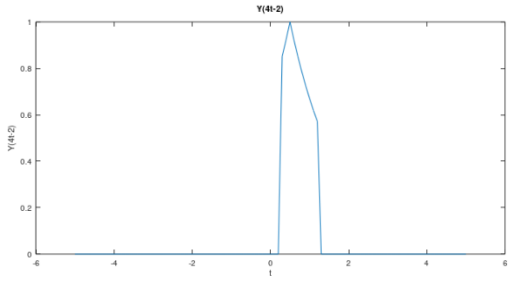
```
t = -5:0.1:5;


subplot(2,2,1), plot(t,Yt(t));
xlabel("t"); ylabel("Y(t)"); title("Y(t)");
subplot(2,2,2), plot(t,Yt(3 .* t));
xlabel("t"); ylabel("Y(3t)"); title("Y(3t)");
subplot(2,2,3), plot(t,Yt(t+2));
xlabel("t"); ylabel("Y(t+2)"); title("Y(t+2)");
subplot(2,2,4), plot(t,Yt(4 .* t-2));
xlabel("t"); ylabel("Y(4t-2)"); title("Y(4t-2)");
```

- Figures







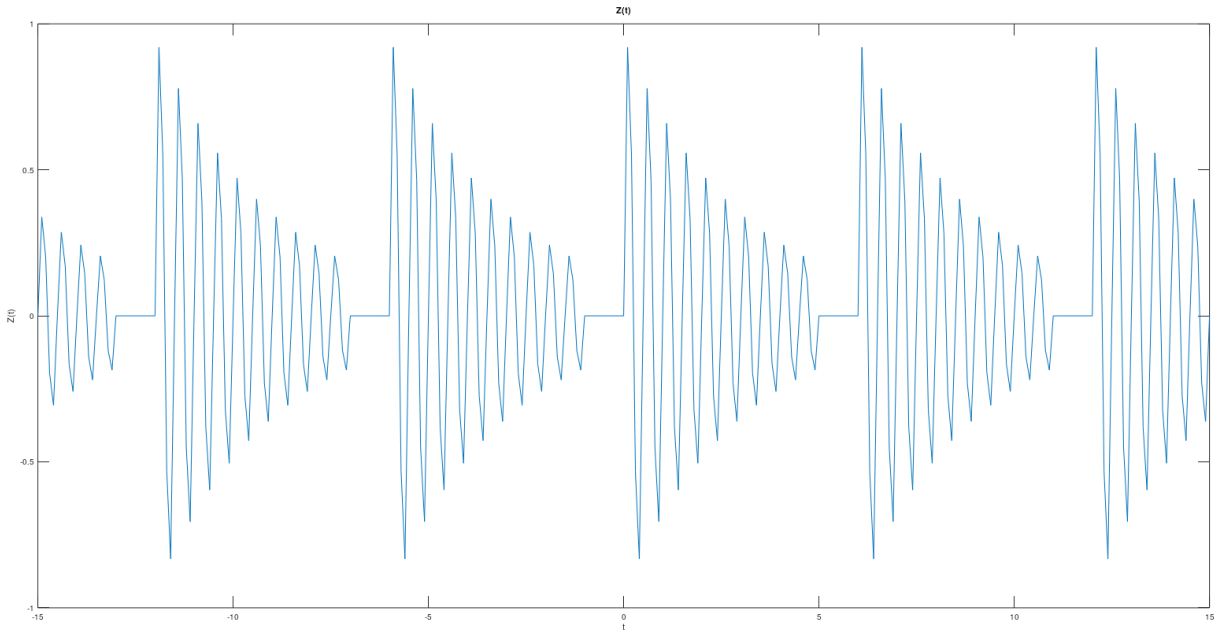


- Part C
  - Source Code

```
t = -15:0.1:15;

T = 6;

Zt = @(x) exp(-1 .* abs(x) ./ 3) .* sin(4 .* pi .* x) .* (ustep(x) - ustep(x-5));


ZtPeriodic = 0;

for i = -3:3

        ZtPeriodic = ZtPeriodic + Zt(t + i .* T);

endfor


plot(t, ZtPeriodic);

xlabel("t"); ylabel("Z(t)"); title("Z(t)");


energy = integral(@(t)Zt(t).^ 2, 0, 6)

power = energy ./ 6
```

- Values of Part C-b
    - Energy = 0.72274
    - Power = 0.12046

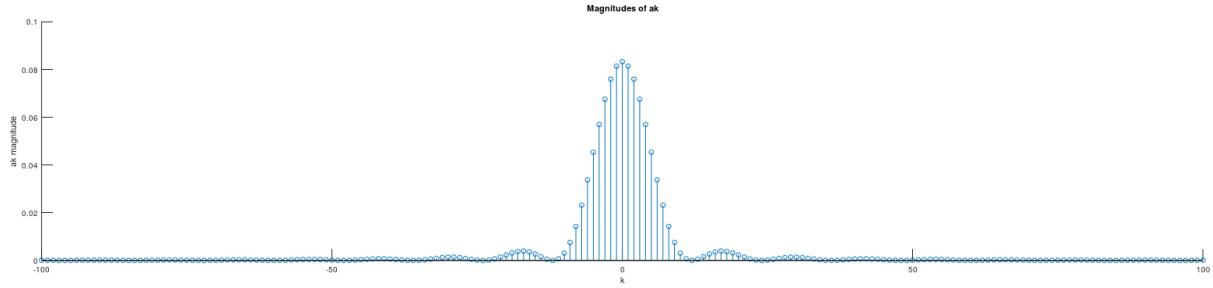
- Figures

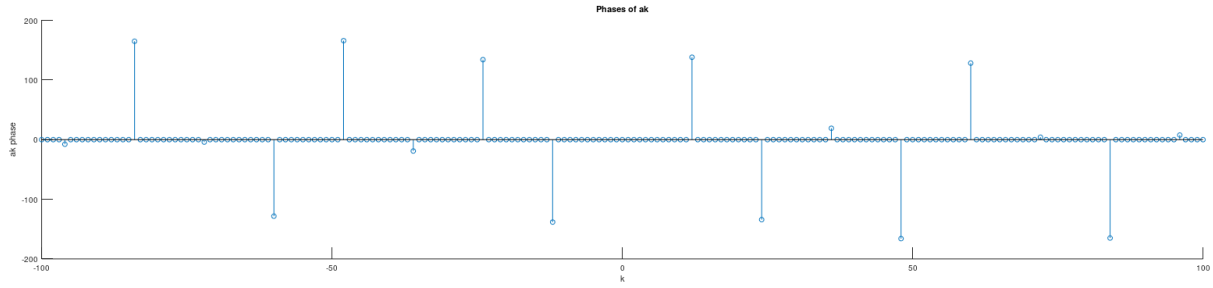


- Part D
  - Source Code

```
#period

T = 6;

#fundamental freq.

w0 = 2 .* pi ./ T;

yMagn = [];

yPhase = [];

f = [];


#coeff.

for m=-100:100

        f = [f m];

        x = (1 ./ T) .* quadgk(@(t) (1-2 .* abs(t)) .* exp(-i .* m .* w0 .* t), -0.5, 0.5);

        yMagn = [yMagn abs(x)];

        yPhase = [yPhase (angle(x) .* 180 ./ pi)];

endfor


#Real Part

subplot(2,1,1), stem(f, yMagn);

xlabel("k"); ylabel("ak magnitude");


#Imaginary Part

subplot(2,1,2), stem(f, yPhase);

xlabel("k"); ylabel("ak phase");
```

- Figures


Magnitudes of ak
ak magnitude
0.1
0.08
0.06
0.04
0.02
0
-100
-50
0
50
100
k


Phases of ak
ak phase
200
100
0
-100
-200
-100
-50
0
50
100
k

- Part E
  - Source Code

```
t = -10:0.01:10;


mt = sin(5 * pi .* t) ./ (pi .* t);

subplot(2,2,1), plot(t,mt);

xlabel("t"); ylabel("m(t)");

title("m(t)");


Mt = fft(mt);

Mt_shifted = fftshift(Mt);

n = length(mt);

f = (-n/2:n/2-1)*(50/n);

subplot(2,2,2), plot(f, abs(Mt_shifted));

xlabel("f"); ylabel("M(jw)");

title("M(jw)");


rt = mt .* cos(30 * pi .* t);

subplot(2,2,3), plot(t,rt);

xlabel("t"); ylabel("r(t)");

title("r(t)");


Rt = fft(rt);

Rt_shifted = fftshift(Rt);

n = length(rt);

f = (-n/2:n/2-1)*(50/n);

subplot(2,2,4), plot(f, abs(Rt_shifted));

xlabel("f"); ylabel("R(jw)");

title("R(jw)");
```

- Comment on E-C
  R(t) can easily be obtained from M(t), and that's because r(t) is derived from m(t)

- Figures