

Lab 1: Basic Signal Representation and Convolution in MATLAB

PART 1: Basic Signal Representation in MATLAB

1.

```
clear all;
Ts=0.01; t= -5:Ts:5;
y1 = ramp(t,3,3);
y2 = ramp(t,-6,1);
y3 = ramp(t,3,0);
y4 = ustep(t,-3);
y = y1-2*y2+3*y3-y4;
plot(t,y,'k'); axis([-5 5 -1 7]); grid

% t: length of time
% m: slope of the ramp
function
% ad: advance (positive),
delay (negative) factor
```

ramp function

```
function y = ramp(t,m,ad)

y=[];

for i=t
    i = i+ad;
    if i<=0
        y = [y 0];
    else
        y = [y m*i];
    end
end

end
```

ustep function

```
function y = ustep(t,ad)

if t<=ad
    y=0;
else
    y=1;
end

end
```

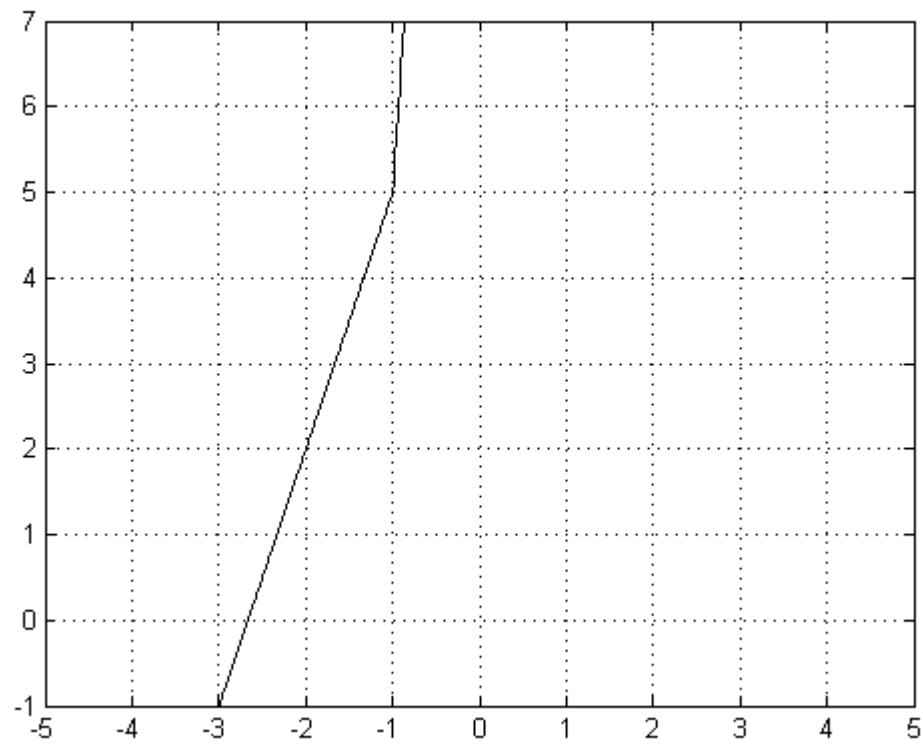


Figure 1: part1_1

2.

```
clear all;  
  
Ts=0.01; t= -5:Ts:5;  
  
x1 = 3*exp(-t);  
x2 = cos(4*pi*t);  
x = x1.*x2;  
  
h = hilbert(x);  
hold on;  
plot(t, x, 'k');grid  
plot(t,-abs(h),'b',  
t,abs(h),'b');  
hold off;
```

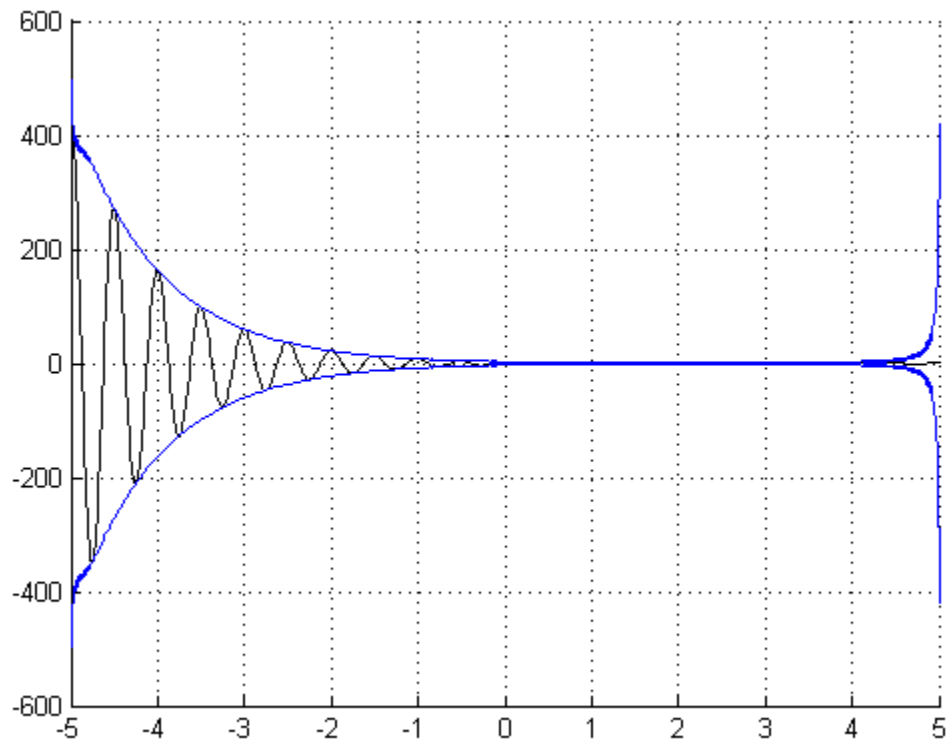


Figure 2: part1_2

PART 2: Time-Domain Convolution

Creating a rectangular pulse in MATLAB & Elementary signal operations

```
f_s = 100;
T_s = 1/f_s;
t = [-5:T_s:5];
x1 = rect(t);
x2 = rect(t-1);
x3 = rect(t/2);
x4 = rect(t)+(1/2)*rect(t-1);
x5 = rect(-t)+(1/2)*rect(-t-1);
x6 = rect(1-t)+(1/2)*rect(-t);

subplot(3,2,1)
plot(t,x1)
axis( [-2 2 -1 2]);
xlabel( 'time (sec)' )
ylabel('x_1(t) = rect(t)')
title ('Plot 1: A rectangular pulse');

subplot(3,2,3)
plot(t,x2)
axis( [-2 2 -1 2]);
xlabel( 'time (sec)' )
ylabel('x_2(t) = x_1(t-1)')
title ('Plot 2: Shifted rectangular pulse');

subplot(3,2,5)
plot(t,x3)
axis( [-2 2 -1 2]);
xlabel( 'time (sec)' )
ylabel('x_3(t) = x_1(t/2)')
title ('Plot 3: Expanded rectangular pulse');

subplot(3,2,2)
plot(t,x4)
axis( [-2 2 -1 2]);
xlabel( 'time (sec)' )
ylabel('x_4(t) = rect(t)+(1/2)rect(t-1)')
title ('Plot 4');

subplot(3,2,4)
plot(t,x5)
axis( [-2 2 -1 2]);
xlabel( 'time (sec)' )
ylabel('x_5(t) = x_4(-t)')
title ('Plot 5');

subplot(3,2,6)
plot(t,x6)
axis( [-2 2 -1 2]);
xlabel( 'time (sec)' )
ylabel('x_6(t) = x_4(1-t)')
title ('Plot 6');
```

rectangular function

```
function x = rect(t)
x=[];
for i=t
    if ((i>-0.5) &&
(i<0.5))
        x = [x 1];
    else
        x = [x 0];
    end
end
end
```

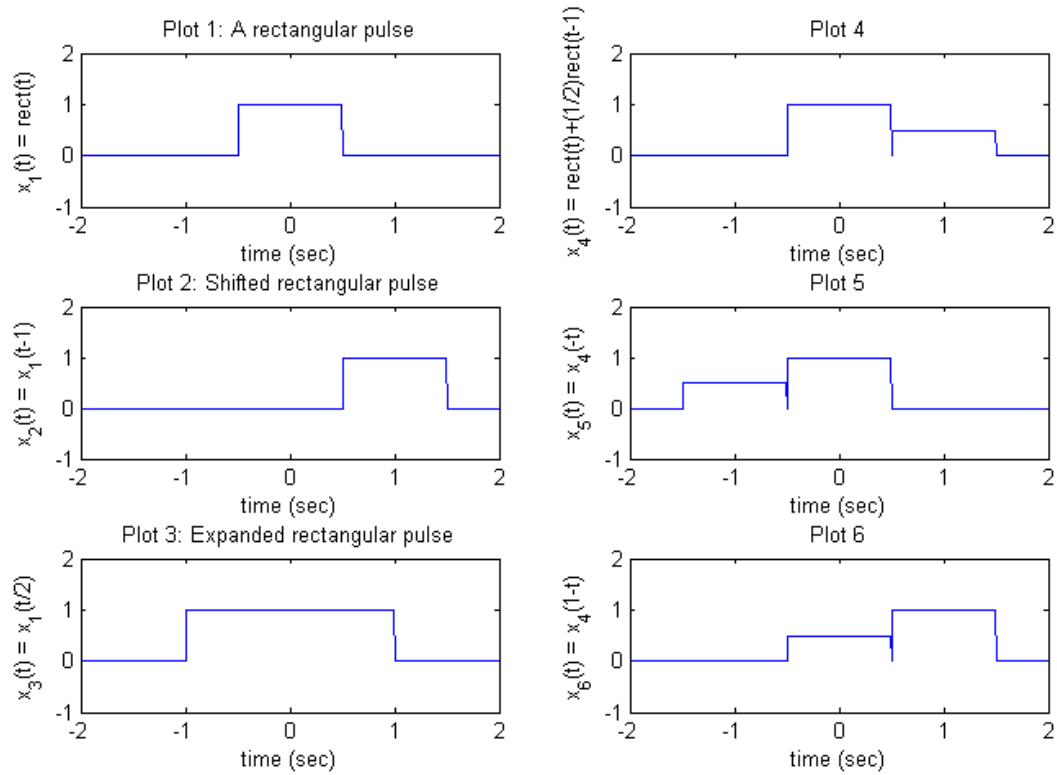
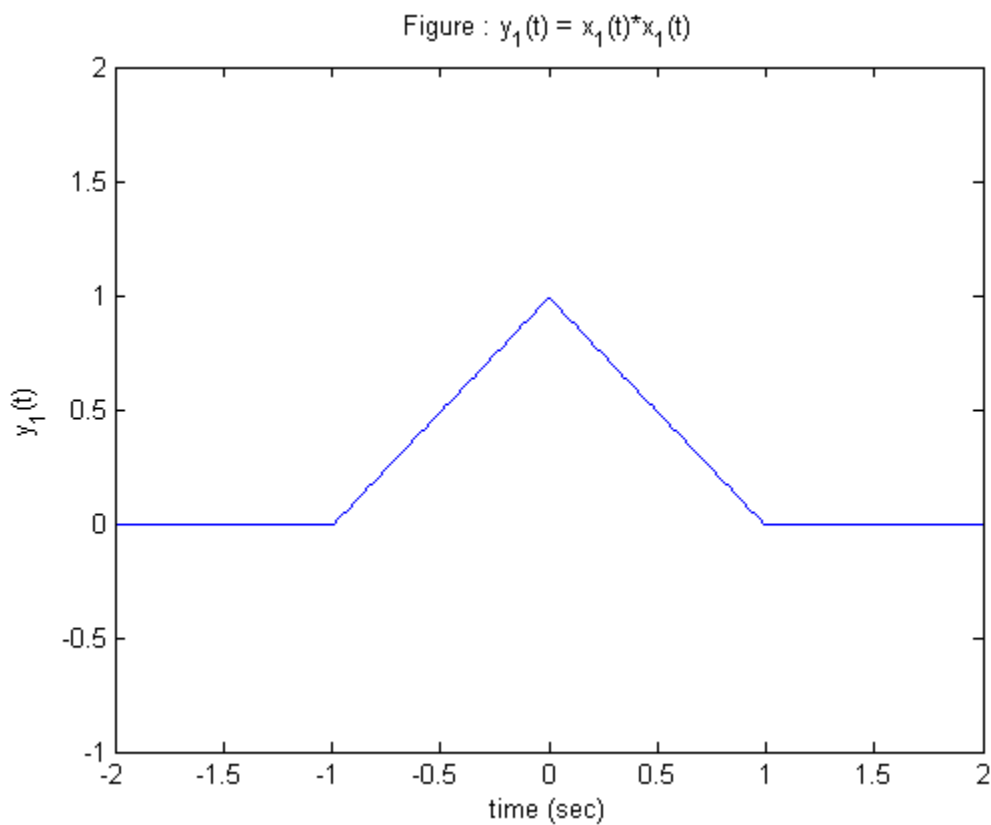


Figure 3 : part2_1

Convolution

```
clear all;  
  
Ts=0.01; t= -5:Ts:5;  
  
x1 = 3*exp(-t);  
x2 = cos(4*pi*t);  
x = x1.*x2;  
  
h = hilbert(x);  
hold on;  
plot(t, x, 'k');grid  
plot(t,-abs(h), 'b',  
t,abs(h), 'b');  
hold off;
```

*Figure 4 : part2_2*

Exercise

1.

```
clear all;
x1 = [1,2,4];
h1 = [1,1,1,1,1];
y1 = conv(x1,h1);
subplot(3,3,1);
stem(x1)
title('Group 1:x1=[1,2,4] & h1=[1,1,1,1,1]');
ylabel('x1');
subplot(3,3,4);
stem(h1)
ylabel('h1');
subplot(3,3,7);
stem(y1)
ylabel('y1');

x2 = [1,2,3,4,5];
h2 = [1];
y2 = conv(x2,h2);
subplot(3,3,2);
stem(x2)
title('Group 2:x2=[1,2,3,4,5] & h2=[1]');
ylabel('x2');
subplot(3,3,5);
stem(h2)
ylabel('h2');
subplot(3,3,8);
stem(y2)
ylabel('y2');

x3 = [1,2,0,2,1];
h3 = [1,2,0,2,1];
y3 = conv(x3,h3);
subplot(3,3,3);
stem(x3)
title('Group 3:x3=[1,2,0,2,1] & h3 = [1,2,0,2,1]');
ylabel('x3');
subplot(3,3,6);
stem(h3)
ylabel('h3');
subplot(3,3,9);
stem(y3)
ylabel('y3');
```

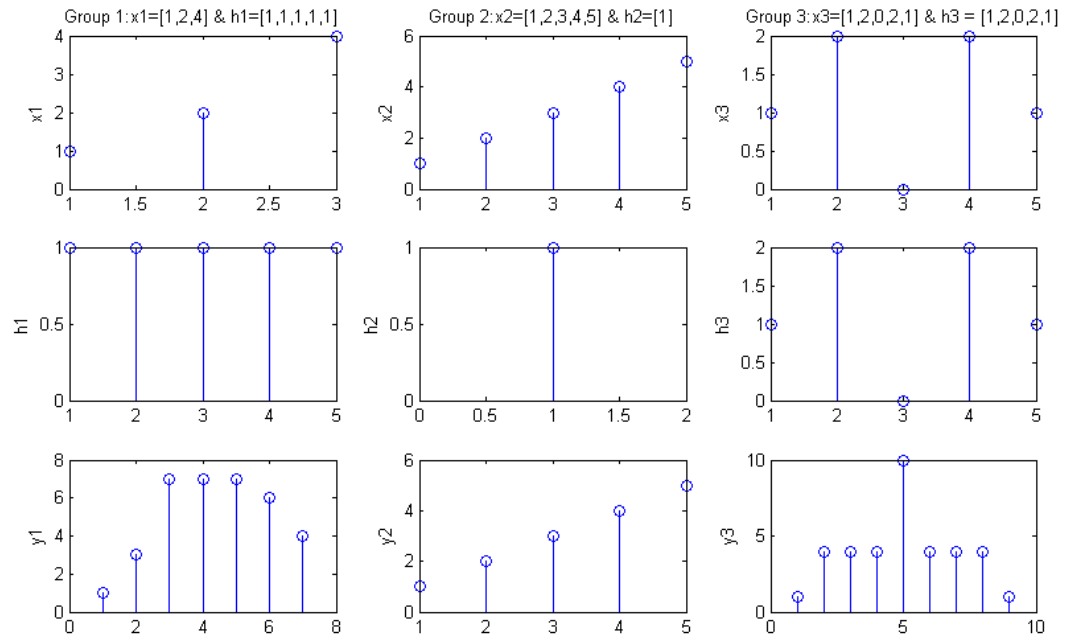


Figure 5 : Ex1

2.

```

y = [1 2 2.5 3 3 3 2 1 0 0 0 0
0 0 0];
x = 0:3;
h = impulse(x);
x_gen = deconv(y,h);

subplot(3,1,1);
stem(x_gen)
ylabel('x generated');
subplot(3,1,2);
stem(h)
ylabel('h');
subplot(3,1,3);
stem(y)
ylabel('y');

```

impulse function

```

function h = impulse(x)

h = [];
for n = x
    if n>=0 && n<4
        h = [h (0.5^n)];
    else
        h = [h 0];
    end
end
end

```

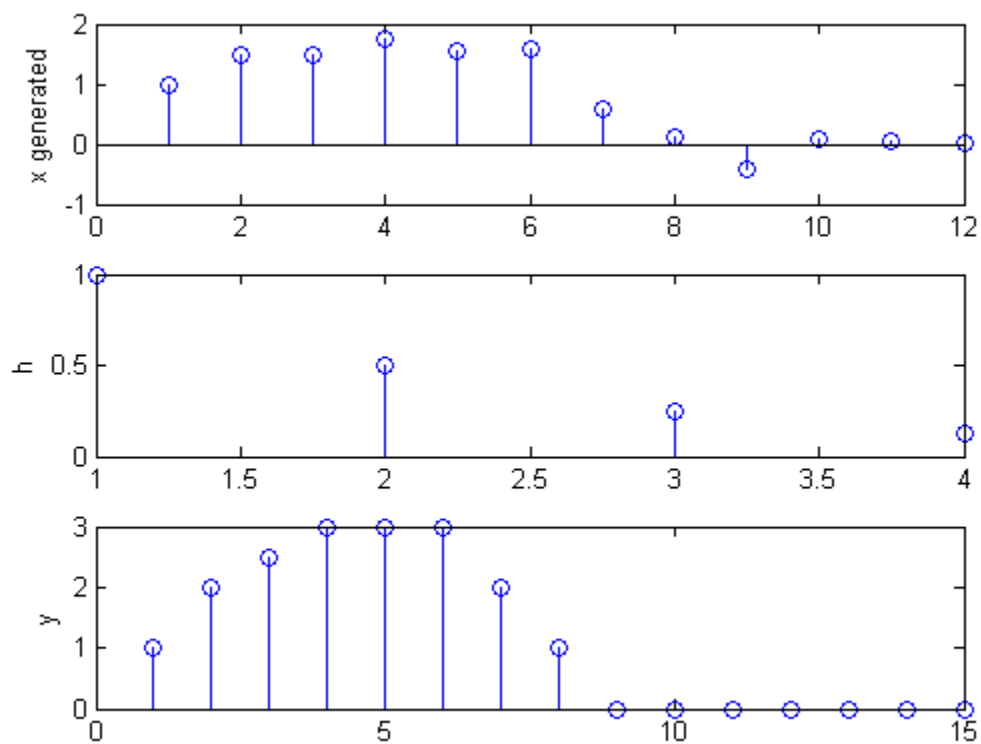


Figure 6 : Ex2