SS EXPERIMENT LAB 4

TITLE: Representation of signal using ramp, impulse functions, and verification of system time-invariancy

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OBSERVATION: In this lab, I learned how to represent signals using ramp, impulse functions and verifying system time-invariancy.

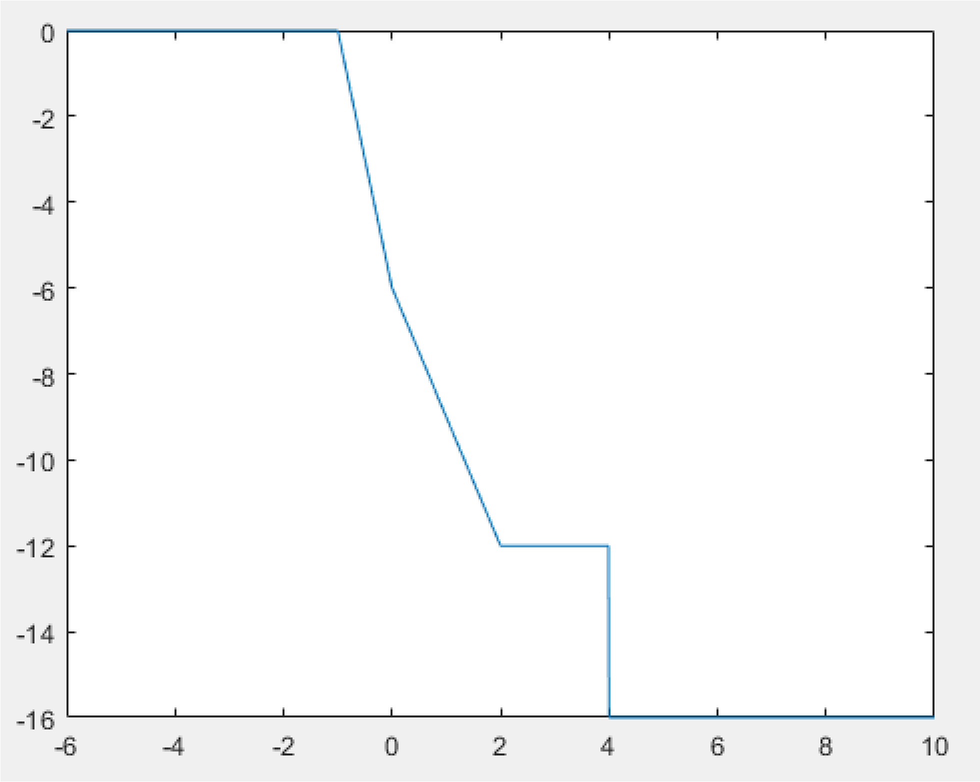
1. Write a MATLAB script to generate the following signal

$$x(t) = 3\,r(t+2) - 6\,r(t+1) + 3\,r(t) - 4\,u(t-4)$$

Then plot the signal and demonstrate analytically that the obtained figure is correct.

Q1.

```
syms u(t) r(t) x(t) t0
u(t)=piecewise(t<t0, 0, t>=t0, 1);
r(t)=piecewise(t<t0, 0, t>=t0, t-t0);
t1=-6:0.01:10;
x(t)= 3*r(t-2)-6*r(t+1)+3*r(t)-4*u(t-4);
x=subs(x,{t0,t},{0,t1});
plot(t1,x);
```



Lab-04

Signal & Systems

Q-1

~~$x(t) = 3r(t+2) - 6r(t+1) + 3r(t) - 9u(t-9)$~~

$$x(t) = -6r(t+1) + 3r(t) + 3r(t-2) - 4u(t-4)$$

Important points → $-1, 0, 2, 4$

Ramp function

$$r(t) = \begin{cases} t & ; t \geq 0 \\ 0 & ; \text{else} \end{cases}$$

$$u(t) = \begin{cases} 1 & ; t \geq 0 \\ 0 & ; \text{else} \end{cases}$$

for $t < -1$

$x(t) = 0$

for $-1 < t < 0$

$x(t) = -6(t+1)$

for $0 < t < 2$

$x(t) = -6(t+1) + 3t$

$= -3t - 6$

for $2 < t < 4$

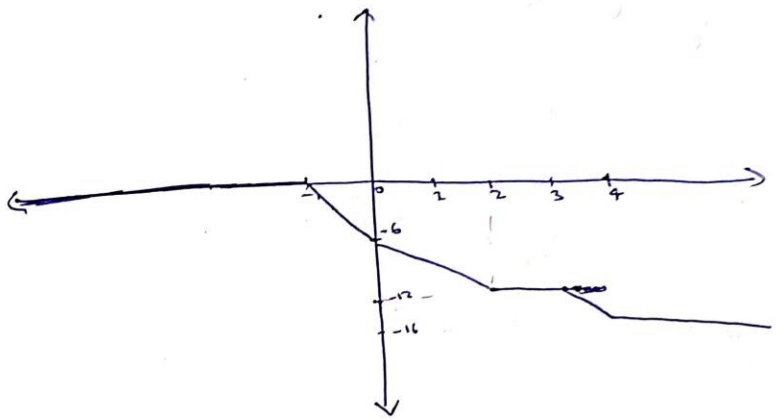
$x(t) = -6(t+1) + 3t + 3(t-2)$

$= \cancel{-3t-6} - 12$

for $t > 4$

$= -16$

$$y(t) = \begin{cases} 0 & t < -1 \\ -6(t+1) & -1 < t < 0 \\ -3t-6 & 0 < t < 2 \\ -12 & 2 < t < 4 \\ -16 & t > 4 \end{cases}$$



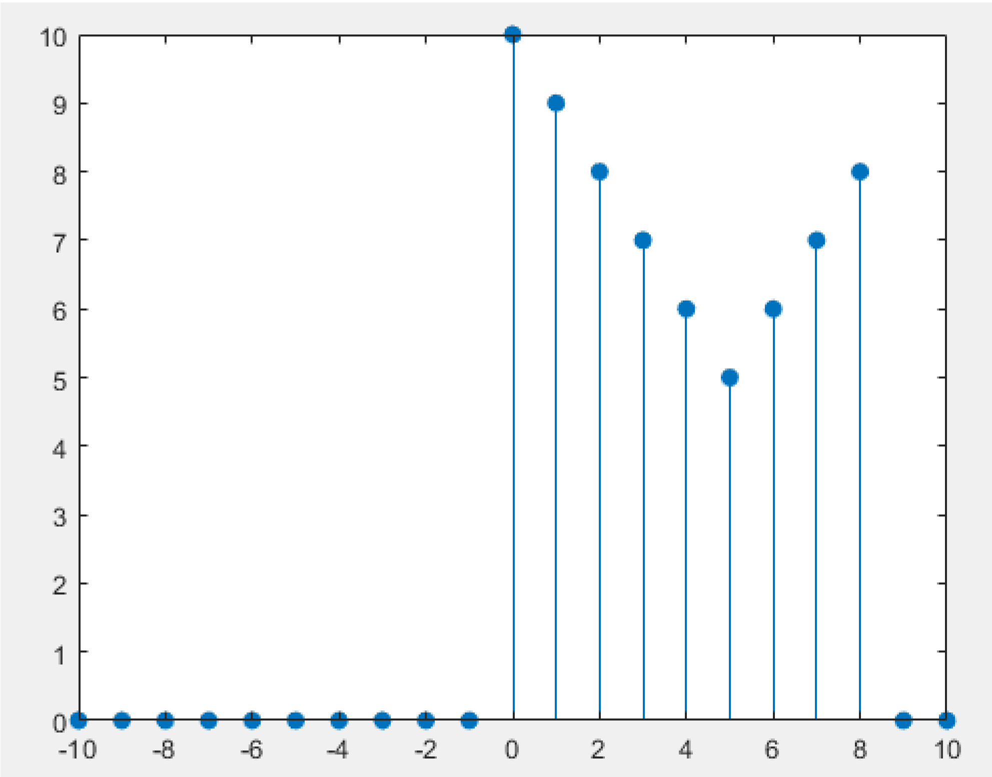
2. Write a MATLAB script to represent the following signal using impulse-function

$$x(n) = \begin{cases} -n + 10, 0 \le n \le 5 \\ n, 6 \le n \le 8 \\ 0, else \end{cases}$$

Then plot the signal and demonstrate analytically that the obtained figure is correct.

Q2.

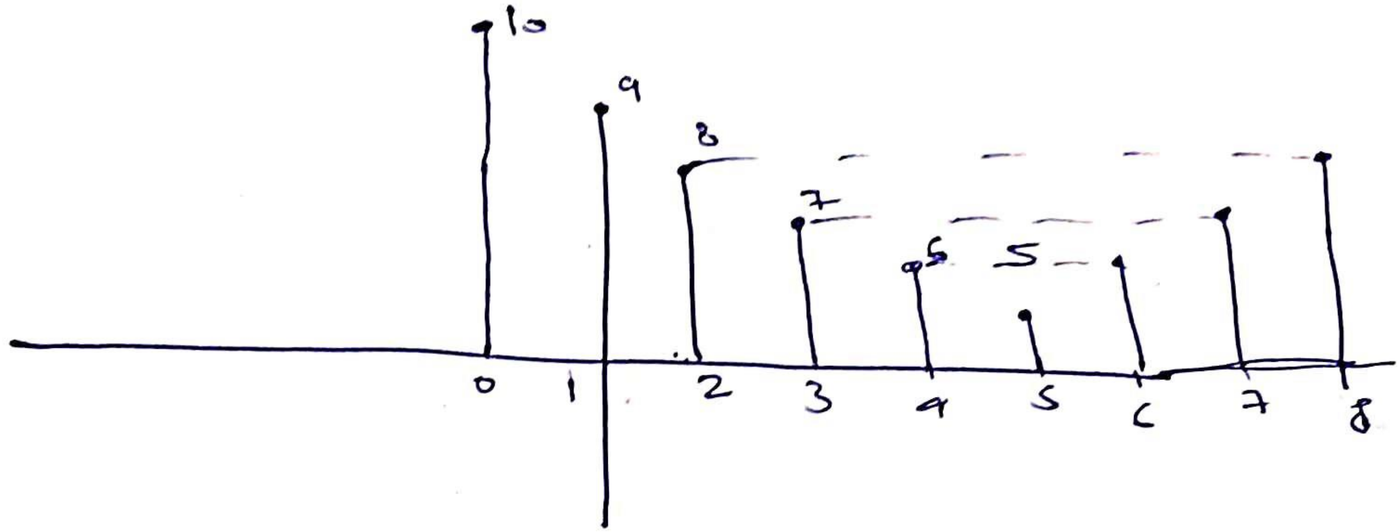
```
n=[-10:1:10];
m=[-10:1:10];
y1=delta_(n,0);
y2=delta_(n,-1);
y3=delta_(n,-2);
y4=delta_(n,-3);
y5=delta_(n,-4);
y6=delta_(n,-5);
y7=delta_(n,-6);
y8=delta_(n,-7);
y9=delta_(n,-8);

stem(m,y1.*(-m+10)+y2.*(-m+10)+y3.*(-m+10)+y4.*(-m+10)+y5.*(-m+10)+y6.*(-m+10)+y7.*(m)+y8.*(m)+y9.*(m),'filled');

function y=delta_(x,r)
    y=[(x+r)==0];


end
```


10
9
8
7
6
5
4
3
2
1
0
-10
-8
-6
-4
-2
0
2
4
6
8
10

Q-2

$$x(n) = \begin{cases} -n+10, & 0 \le n \le 5 \\ n, & 6 \le n \le 8 \\ 0, & \text{else} \end{cases}$$

$$x[n] = 10\,\delta[n] + 9\,\delta[n-1] + 8\,\delta[n-2] + 7\,\delta[n-3] + 6\,\delta[n-4] + 5\,\delta[n-5] + 6\,\delta[n-6] + 7\,\delta[n-7] + 8\,\delta[n-8]$$



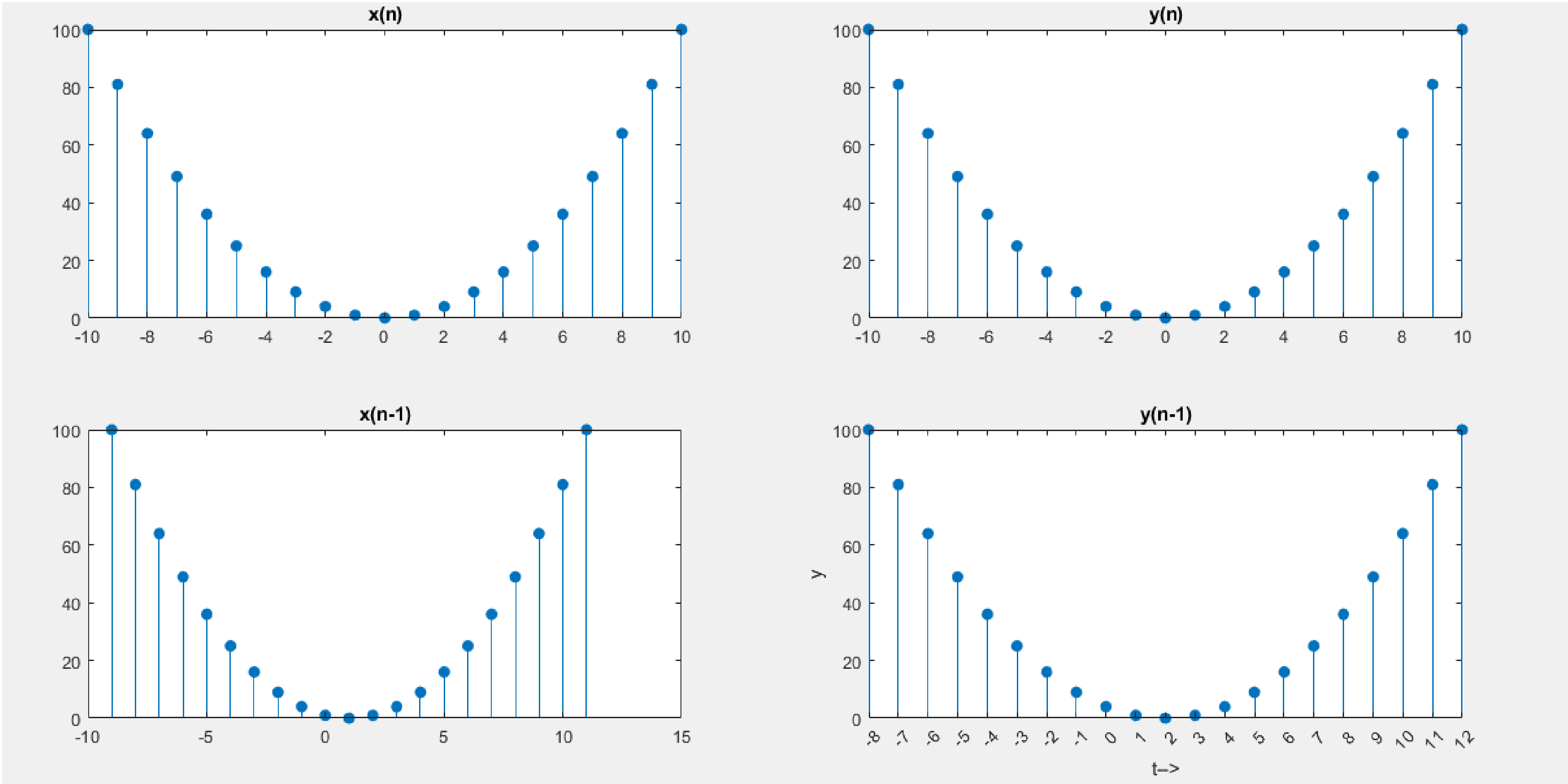
3. Write a MATLAB script to graphically demonstrate whether the following system is Time-invariance or not.

$$y(n) = \tau\{x(n)\} = x(-n)$$

Then verify with the analytical result.

Q3.

```
n=-10:10;
x1=n.^2;
subplot(2,2,1);
stem(n,x1,'filled');
title('x(n)');
[y1,n]=sigfold(x1,n);
subplot(2,2,2);
stem(n,y1,'filled');
title('y(n)');
k=1;
[x2,n]=sigshift(x1,n,k);
subplot(2,2,3);
stem(n,x2,'filled');
title('x(n-1)');
[y2,n]=sigshift(y1,n,k);
subplot(2,2,4);
stem(n,y2,'filled');
xlabel('t-->');
ylabel('y');
title('y(n-1)');
xticks(n);

function [y,n] = sigfold(x,n)
y = fliplr(x);
n = -fliplr(n);
end

function [y,n] = sigshift(x,m,k)
n = m+k;
y = x;
end
```


x(n)
y(n)
x(n-1)
y(n-1)
y
t-->

Q-3

$y(n) = T(x(n)) = x(-n)$

Delay in input

$y(n) = (-n-n_0)$

Delay in output

$y(n-n_0) = x(-n+n_0)$

So, there two are time variant.