Independent University, Bangladesh

Department of Electrical and Electronic Engineering

BAETE Accredited

Course Title : Digital Signal Processing LAB
Course Code : EEE 321L / ETE 324L [New]; ECR 305L [Old]
Instructor : Dr. Kh Shahriya Zaman
Experiment No. : **03**
Experiment Name : **Study on signal manipulation.**

Objectives:

1. Performing the signal addition, multiplication, division and scaling using MATLAB.
2. Obtaining the magnitude, real part, imaginary part and phase angle of a complex signal using MATLAB.

Lab work:

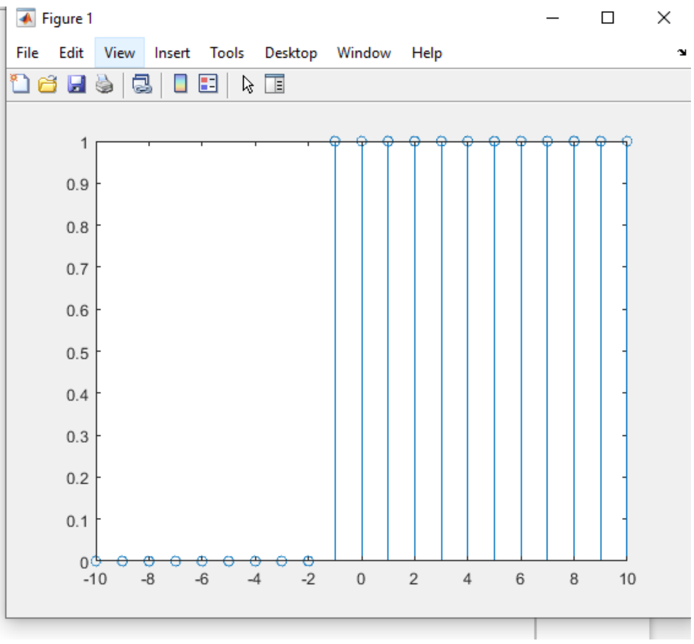
1. **(i) Generate the following signals**:
   a. $x[n] = u(n+1)$ where $-10 \le n \le 10$

   Comment: This signal is a unit step function shifted 1 unit to the left.

```
% Name: Hemal Sharma
%ID: 2221855

%x[n] = u(n+1) where -10 ≤ n ≤ 10

n = -10:10
x = stepseq(-1,-10,10)
stem(n,x)
```



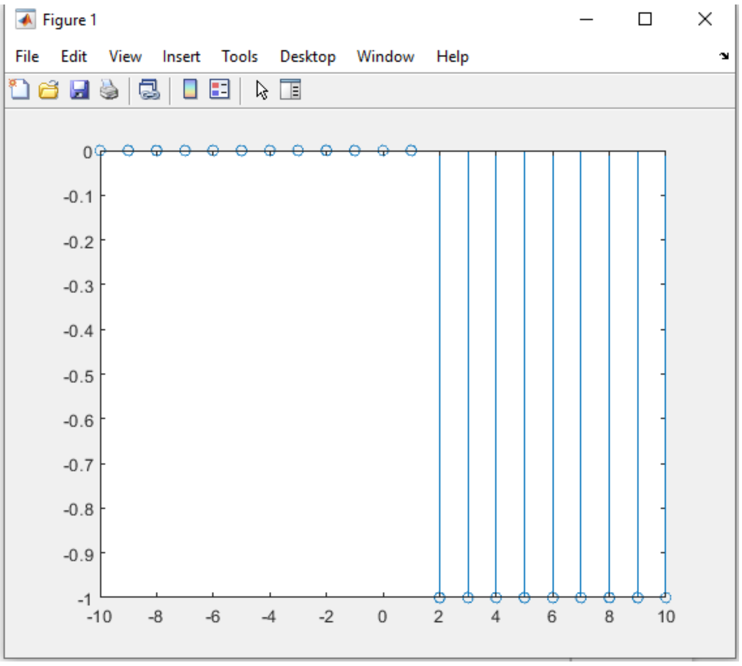
b. $x[n] = -u(n-2)$ where $-10 \leq n \leq 10$

Comment: This signal is a unit step function shifted 2 units towards the right and the amplitude is scaled by a factor of -1 hence the signal is reflected about the n axis.

```
% Name: Hemal Sharma
%ID: 2221855

%x[n] = -u(n-2) where -10 ≤ n ≤ 10

n = -10:10
x = -1*stepseq(2,-10,10)
stem(n,x)
```



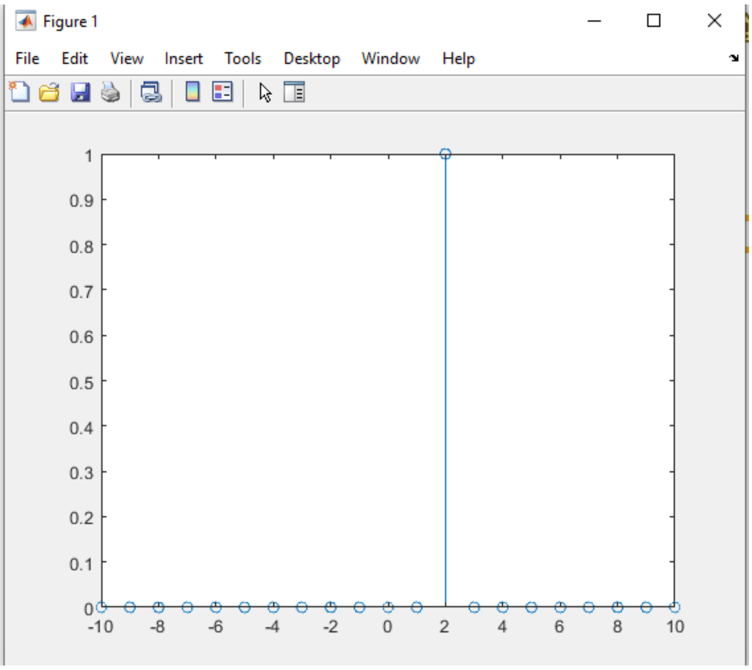
c. $x[n] = \delta(n-2)$ where $-10 \leq n \leq 10$

Comment: The signal is a unit impulse function shifted 2 units toward the left.

```
% Name: Hemal Sharma
%ID: 2221855

%x[n] = δ(n-2) where -10 ≤ n ≤ 10

n = -10:10
x = impseq(2,-10,10)
stem(n,x)
```



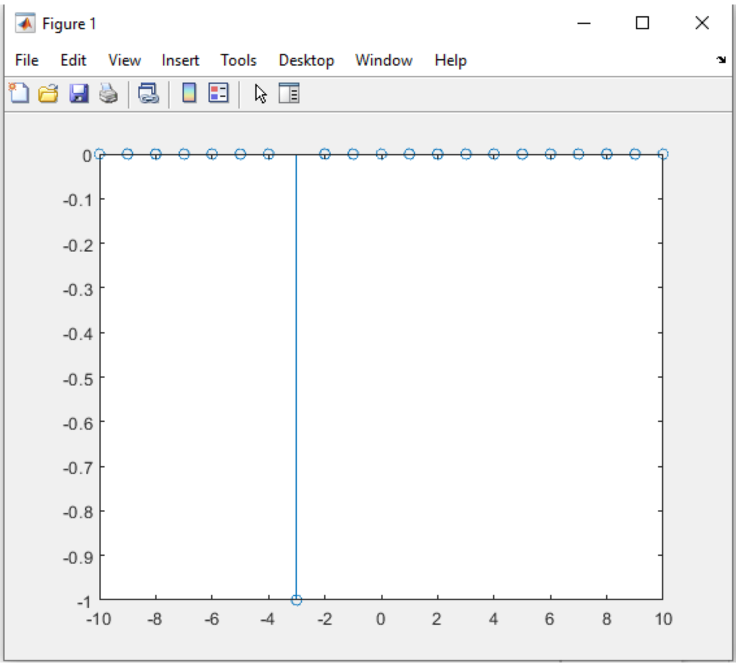
d. x[n] = - δ(n+3)) where -10 ≤ n ≤ 10

Comment: The unit impulse function is shifted 3 units towards the left and the amplitude is scaled by a factor of -1 hence the signal is reversed about the n axis.

```
% Name: Hemal Sharma
%ID: 2221855

%x[n] = -δ(n+3) where -10 ≤ n ≤ 10

n = -10:10
x = -1*impseq(-3,-10,10)
stem(n,x)
```



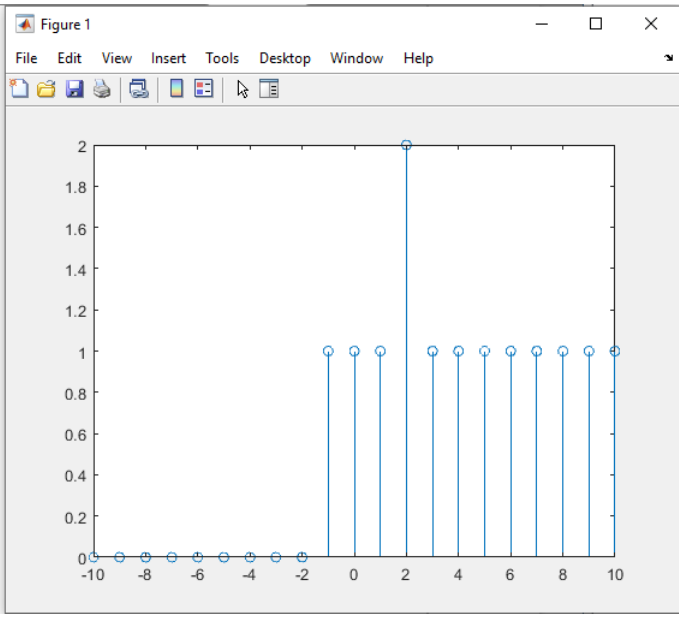
e. x[n] = u(n+1) + δ(n-2) where -10 ≤ n ≤ 10

Comment: The unit step function and the unit impulse function is summed. However, the unit step function is shifted 1 unit towards the left and the unit impulse function is shifted 2 unit toward the right.

```
% Name: Hemal Sharma
%ID: 2221855

%x[n] = u(n+1) + δ(n-2) where -10 ≤ n ≤ 10

n = -10:10
x = stepseq(-1,-10,10) + impseq(2,-10,10)
stem(n,x)
```

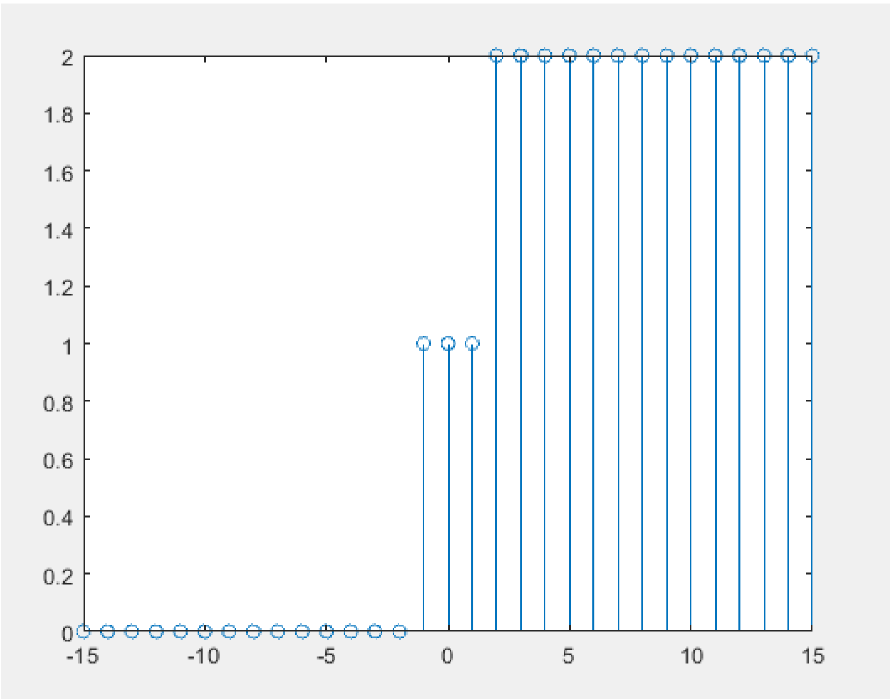


2. Generate the following signals. Use *stem* function to plot **x[n]** and **comment** on the results in each case.

[a] **$x[n] = u[n + 1] + u[n - 2]$,** where **$-15 \leq n \leq 15$** [addition]

Comment: The two unit step functions are added however, the first unit step function is shifted 1 unit towards the left and the second unit step function is shifted 2 units towards the right

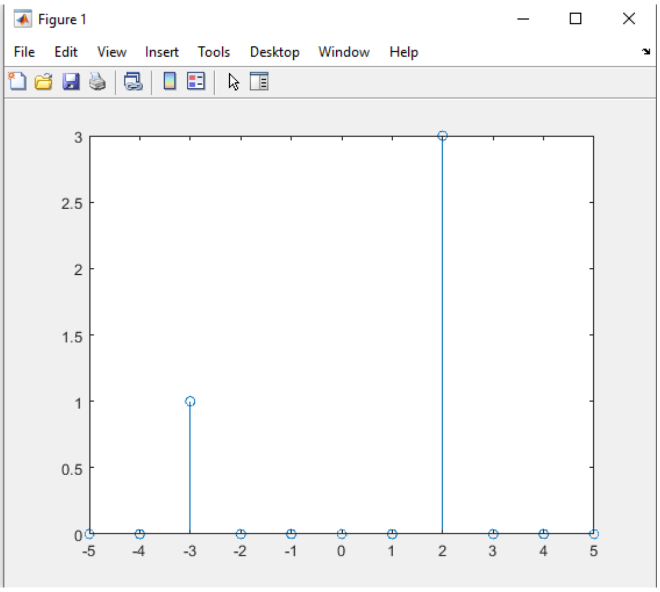
```
%Hemal Sharma
%ID: 2221855
%x[n] = u[n + 1] + u[n - 2], where -15 ≤ n ≤ 15 [addition]
n = -15:15;
x = unitstep(-1,-15,15) + unitstep(2,-15,15);
stem(n,x)
```



[b] **x[n] = δ[n + 3] + 3δ[n – 2],** where **–5 ≤ n ≤ 5** [addition and scaling]

Comment: The two unit impulse functions are added. The first function is shifted 3 units toward the left and the second impulse function is shifted 2 units toward the right and the amplitude of it is scaled by a factor of 3

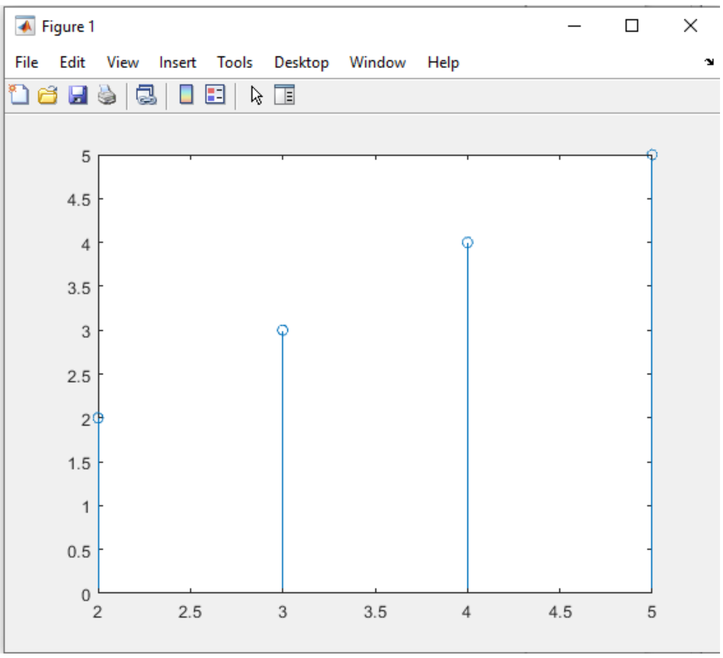
```
%Hemal Sharma
%ID: 2221855
%x[n] = δ[n + 3] + 3δ[n - 2], where -5 ≤ n ≤ 5
n = -5:5;
x = impseq(-3,-5,5) + 3*impseq(2,-5,5);
stem(n,x)
```



[c] **x[n] = n/u[n – 2],** where **–5 ≤ n ≤ 5** [division]

Comment: n is divided with a unit step function shifted 2 units towards the right.

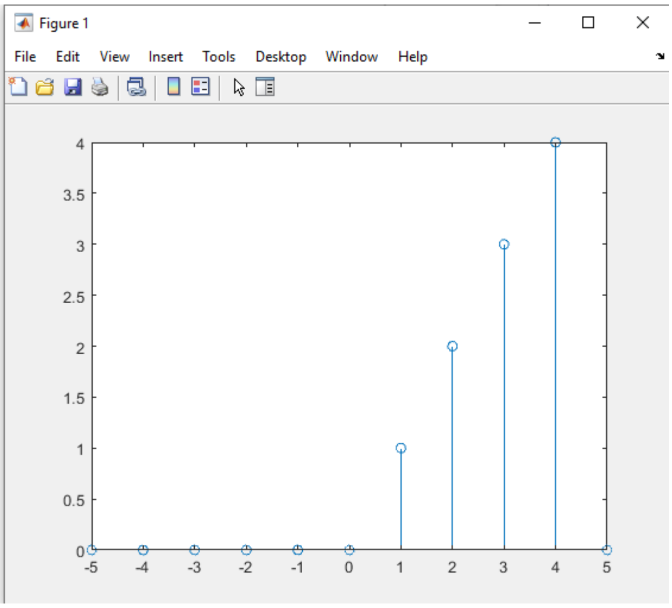
```
%Hemal Sharma
%ID: 2221855
% x[n] = n/u[n - 2], where -5 ≤ n ≤ 5
n = -5:5;
x = n./unitstep(2,-5,5);
stem(n,x)
```



[d] **x[n] = n(u[n] – u[n – 5]),** where **–5 ≤ n ≤ 5** [multiplication]

Comment: Firstly, the unit step function shifted 5 units toward the right is subtracted from a unit step function. And then the amplitude of entire function is by a factor of n.

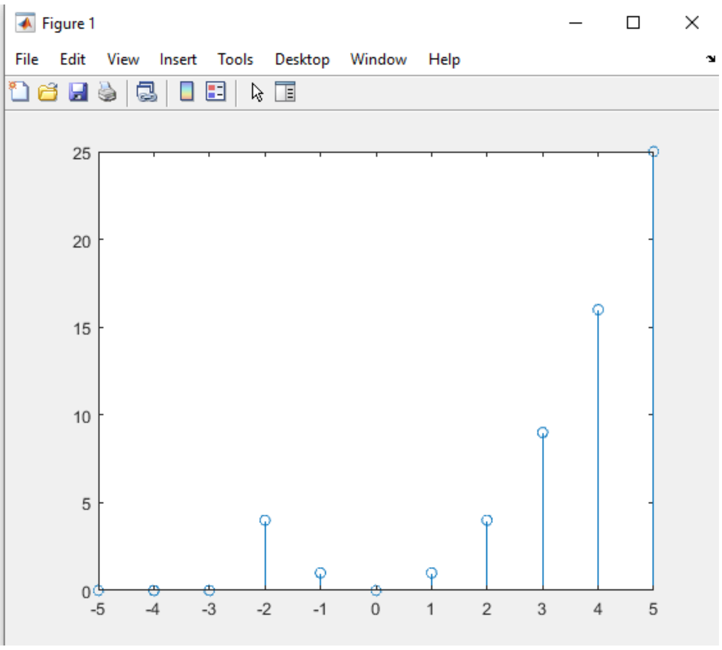
```
%Hemal Sharma
%ID: 2221855
% x[n] = n(u[n] - u[n - 5]), where -5 ≤ n ≤ 5
n = -5:5;
x = n.*(unitstep(0,-5,5) - unitstep(5,-5,5));
stem(n,x)
```



[e] **x[n] = n^{2}u[n + 2],** where **–5 ≤ n ≤ 5** [scaling]

Comment: The unit step function is shifted toward the left by 2 units and the amplitude is scaled by a factor of n squared.

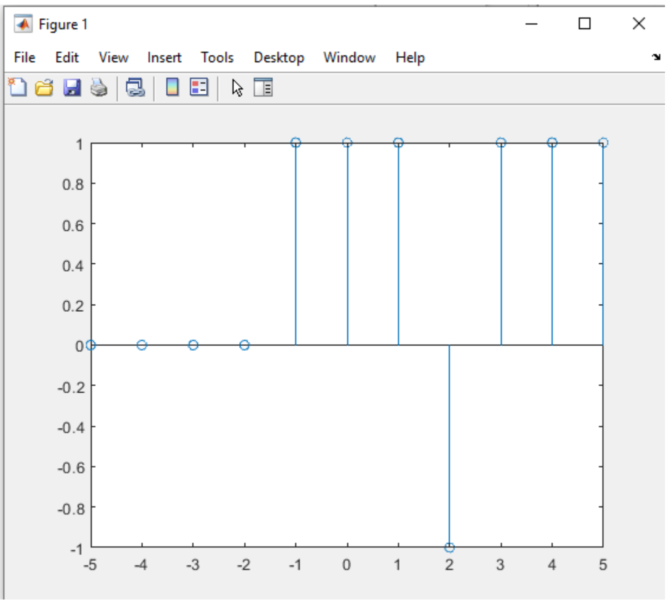
```
%Hemal Sharma
%ID: 2221855
%x[n] = n^2*u[n + 2], where -5 ≤ n ≤ 5
n = -5:5;
x = n.^2.*(unitstep(-2,-5,5));
stem(n,x)
```



[f] **x[n] = u[n + 1] – 2δ[n – 2],** where **–5 ≤ n ≤ 5** [addition and scaling]

Comment: The unit impulse function is shifted 2 units towards the right and the amplitude of it is scaled by a factor of 2. Then the function is subtracted from a unit step function shifted1 unit toward the left.

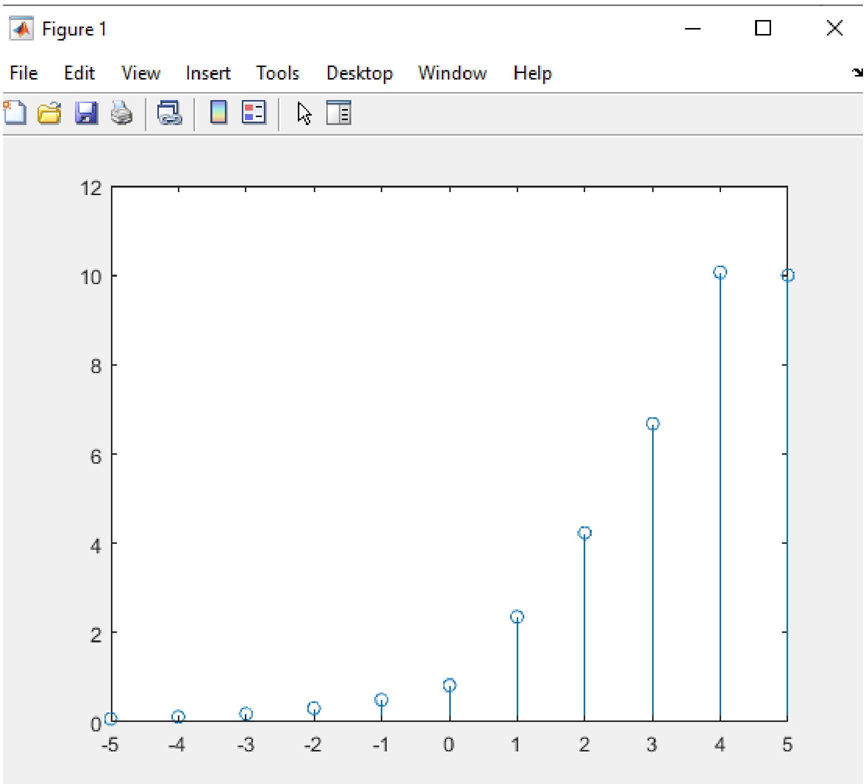
```
%Hemal Sharma
%ID: 2221855
%x[n] = u[n + 1] - 2δ[n - 2], where -5 ≤ n ≤ 5
n = -5:5;
x = unitstep(-1,-5,5) - 2.* impseq(2,-5,5);
stem(n,x)
```



[g] **x[n] = n(u[n] – u[n – 5]) + 10e$^{\mathbf{0.5[n-5]}}$,** where **–5 ≤ n ≤ 5** [scaling]

Comment: The unit step function shifted 5 units toward the right is subtracted from another unit step function and the entire function is scaled by a factor of n. Then it is added with an exponential function shifted 5 units toward the right and the time is scaled by a factor of 0.5 and the amplitude is scaled by a factor of 10.

```
%Hemal Sharma
%ID: 2221855
%[g] x[n] = n(u[n] - u[n - 5]) + 10e 0.5[n - 5] , where -5 ≤ n ≤ 5 [scaling]
n = -5:5;
x = n.*(unitstep(0,-5,5) - unitstep(5,-5,5)) +10*exp(0.5*(n-5));
stem(n,x)
```



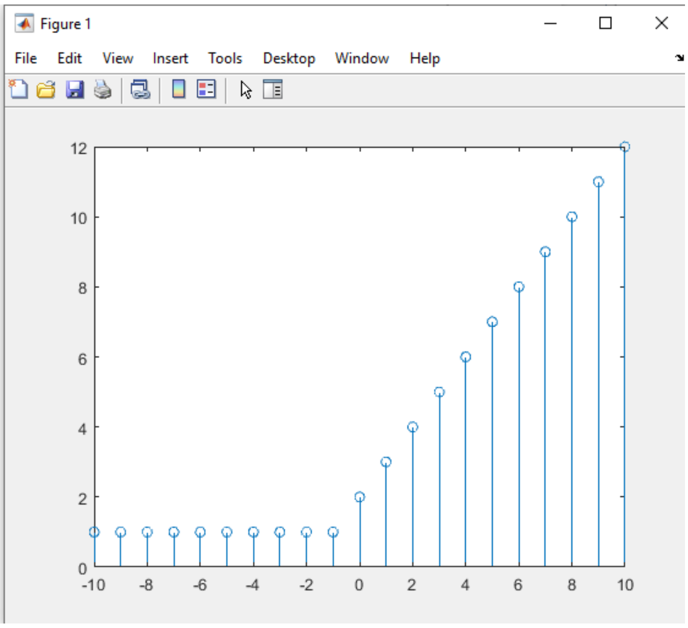
Lab Assignment-3:

If **r[n]** is a ramp function, plot the following functions using the *stem* function:

(i) **x[n] = r[n + 1] + 1,** where **−10 ≤ n ≤ 10**

Comment: The ramp signal is shifted 1 unit towards the left and is added with 1.

```
%Hemal Sharma
%ID: 2221855
%x[n] = r[n + 1] + 1, where -10 ≤ n ≤ 10
n = -10:10;
x = rampseq(-1,-10,10) + 1;
stem(n,x)
```



(ii) **x[n] = n – r[n – 2],** where **–15 ≤ n ≤ 15**

Comment: The ramp signal is shifted 2 units toward the right and is subtracted from n.

```
%Hemal Sharma
%ID: 2221855
% x[n] = n - r[n - 2], where -15 ≤ n ≤ 15
n = -15:15;
x = n - rampseq(2,-15,15) + 1;
stem(n,x)
```