MASTER OF SCIENCE

DEPARTMENT OF ELECTRONIC SCIENCE

Assignment-3

Digital Signal Processing

Submitted To-

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Practical-3

Aim- Write a MATLAB script to check for the properties of discrete-time system:
1) Linearity,
2) Time-invariance,
3) Causality and
4) Stability

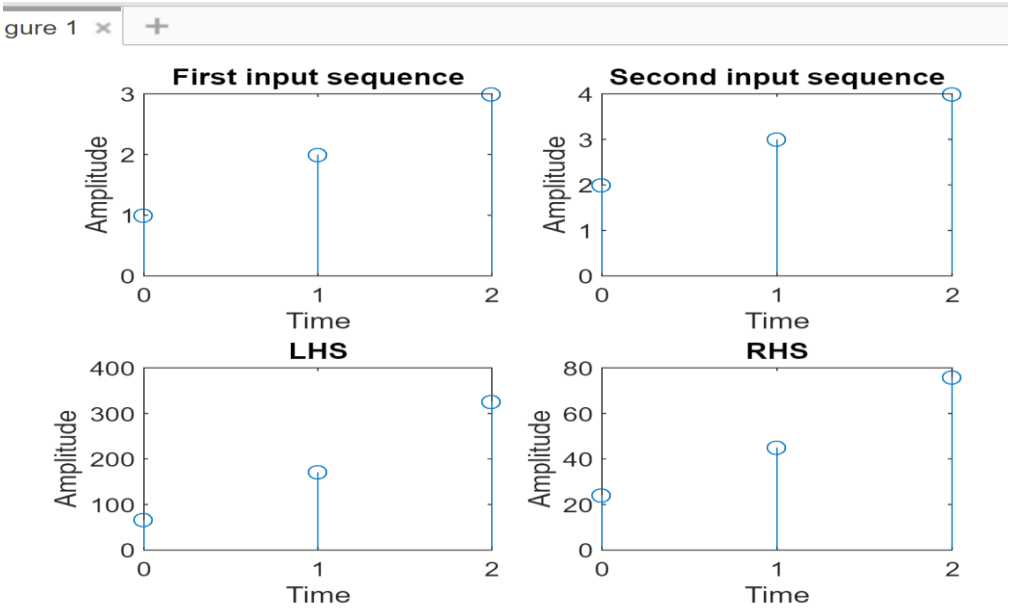
Code-1(when system is non-linear)

```
%properties of dt system(linear and non -linear)
clc;
clear all;
close all;
%Properties of DT Systems(Linearity)
%y(n)=[x(n)]^2+B;
x1=input('Enter first input sequence:');
n=length(x1);
x2=input('Enter second input sequence:');
a=input('Enter scaling constant(a):');
b=input('Enter scaling constant(b):');
B=input('Enter scaling constant(B):');
y1=power(x1,2)+B;
y2=power(x2,2)+B;
rhs=a.*y1+b.*y2;
x3=a.*x1+b.*x2;
lhs=power(x3,2)+B;
subplot(2,2,1);
stem(0:n-1,x1);
xlabel('Time');
ylabel('Amplitude');
title('First input sequence');

subplot(2,2,2);
stem(0:n-1,x2);
xlabel('Time');
ylabel('Amplitude');
title('Second input sequence');

subplot(2,2,3);
stem(0:n-1,lhs);
xlabel('Time');
ylabel('Amplitude');
title('LHS');
```

```
subplot(2,2,4);
stem(0:n-1,rhs);
xlabel('Time');
ylabel('Amplitude');
title('RHS');
if(lhs==rhs)
disp('system is linear');
else
disp('system is non-linear');
end;
```

Output-

```
COMMAND WINDOW
Enter first input sequence:
[1 2 3]
Enter second input sequence:
[2 3 4]
Enter scaling constant(a):
2
Enter scaling constant(b):
3
Enter scaling constant(B):
2
system is non-linear
>>
```



Code-2(when system is linear)

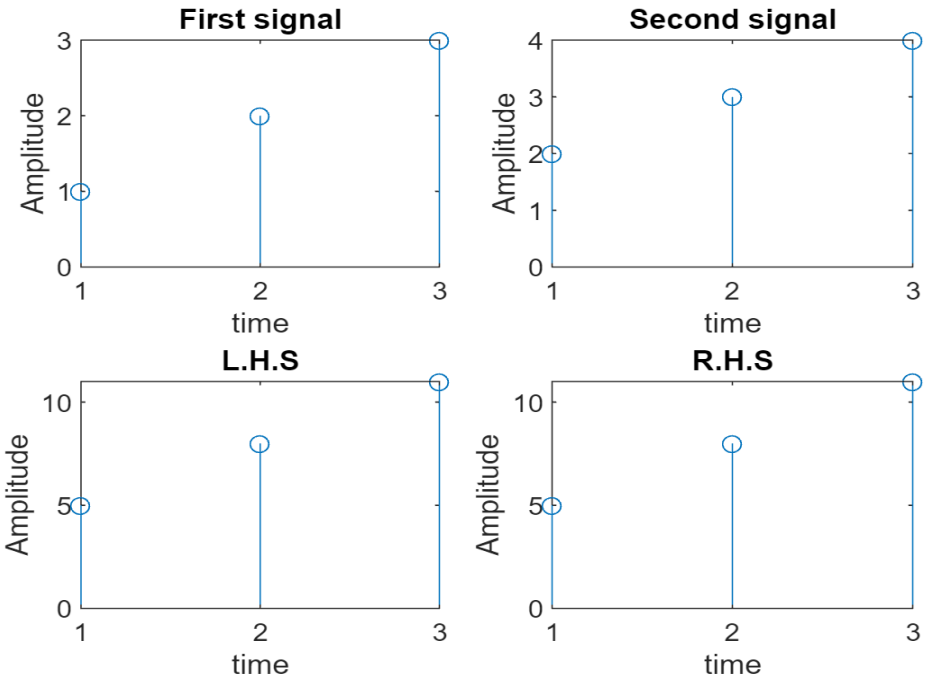
```
clc;
clear all;
close all;
%Properties of DT Systems(Linearity)
%y(n)=x(n);
x1=input('Enter first input sequence:');
x2=input('Enter second input sequence:');
a=input('Enter scaling constant(a):');
b=input('Enter scaling constant(b):');
subplot(2,2,1);
stem(x1);
xlabel('time');
ylabel('Amplitude');
title('First signal');

subplot(2,2,2);
stem(x2);
xlabel('time');
ylabel('Amplitude');
title('Second signal');

y1=x1;
y2=x2;
rhs=a*y1+b*y2;
x3=a*x1+b*x2;
lhs=x3;
if(lhs==rhs)
disp('system is linear');
else
disp('system is non-linear');
end;

subplot(2,2,3);
stem(lhs);
xlabel('time');
ylabel('Amplitude');
title('L.H.S');

subplot(2,2,4);
stem(rhs);
xlabel('time');
ylabel('Amplitude');
title('R.H.S');
```

Output-

COMMAND WINDOW

```
Enter first input sequence:
[1 2 3]
Enter second input sequence:
[2 3 4]
Enter scaling constant(a):
1
Enter scaling constant(b):
2
system is linear
>>
```

Figure 1



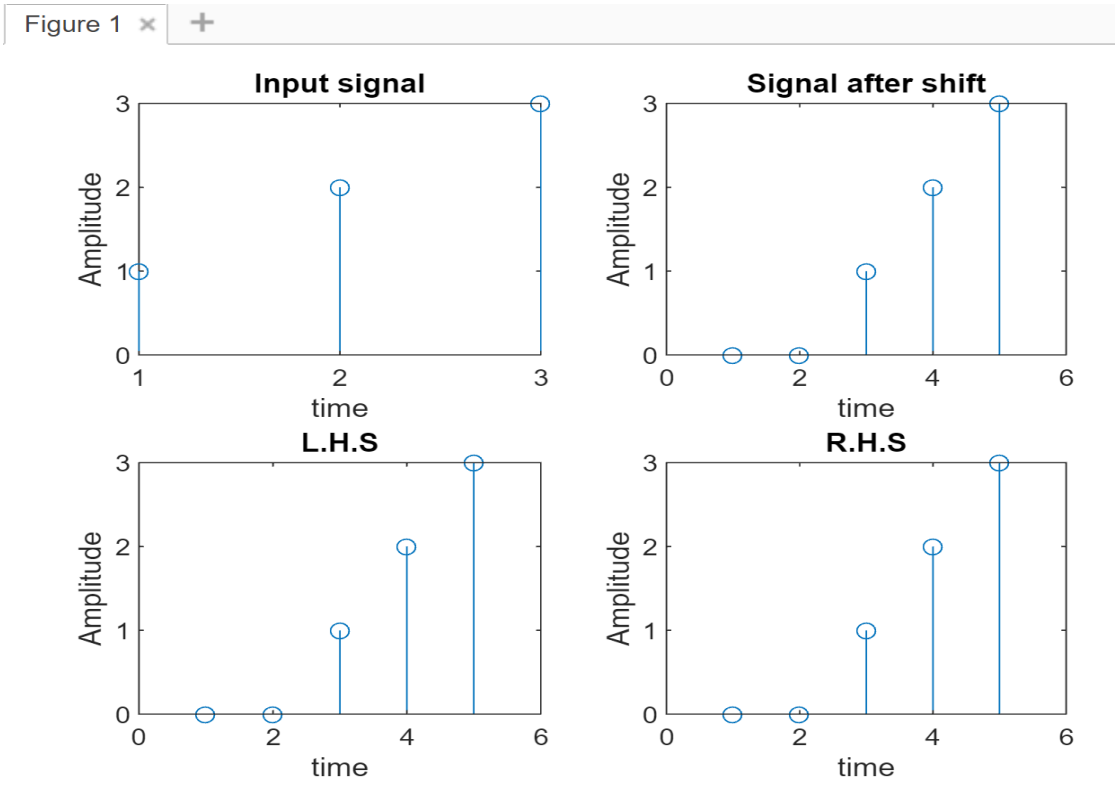
Code-3(when system is time invariant)

```
clc;
clear all;
close all;
%Properties of DT Systems(Time Invariance)
%y(n)=x(n);
x1=input('Enter input sequence x1:');
n0=input('Enter shift:');
x2=[zeros(1,n0),x1];
y1=x1;
y2=x2;
y3=[zeros(1,n0),y1];
if(y2==y3)
disp('system is time invariant');
else
disp('system is time variant');
end;

subplot(2,2,1);
stem(x1);
xlabel('time');
ylabel('Amplitude');
title('Input signal');

subplot(2,2,2);
stem(x2);
xlabel('time');
ylabel('Amplitude');
title('Signal after shift');

subplot(2,2,3);
stem(y2);
xlabel('time');
ylabel('Amplitude');
title('L.H.S');

subplot(2,2,4);
stem(y3);
xlabel('time');
ylabel('Amplitude');
title('R.H.S');
```

Output-

COMMAND WINDOW

```
Enter input sequence x1:
[1 2 3]
Enter shift:
2
system is time invariant
>>
```



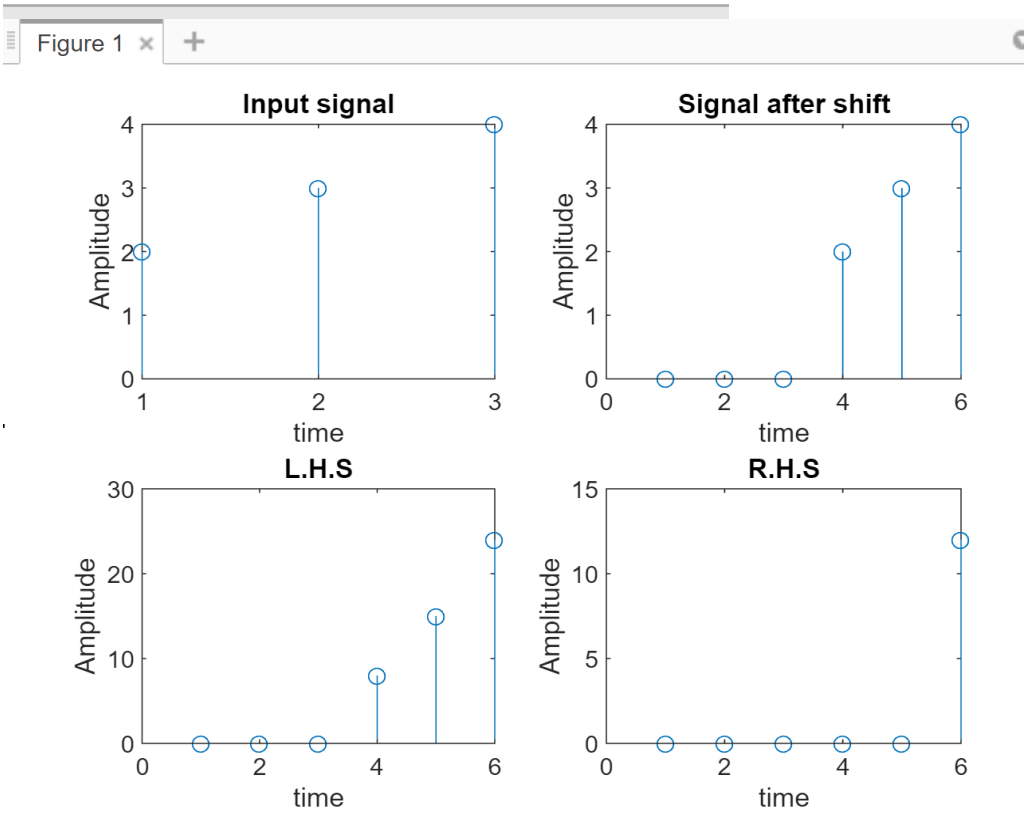
Code-4(when system is time variant)

```
clc;
clear all;
close all;
%Properties of DT Systems(Time Invariance)
%y(n)=n*[x(n)];
x1=input('Enter input sequence x1:');
n1=length(x1);
for n=1:n1
y1(n1)=n.*x1(n);
end;
n0=input('Enter shift:');
x2=[zeros(1,n0),x1];
for n2=1:n1+n0
y2(n2)=n2.*x2(n2);
end;
y3=[zeros(1,n0),y1];
if(y2==y3)
disp('system is time invariant');
else
disp('system is time variant');
end;
subplot(2,2,1);
stem(x1);
xlabel('time');
ylabel('Amplitude');
title('Input signal');

subplot(2,2,2);
stem(x2);
xlabel('time');
ylabel('Amplitude');
title('Signal after shift');

subplot(2,2,3);
stem(y2);
xlabel('time');
ylabel('Amplitude');
title('L.H.S');

subplot(2,2,4);
stem(y3);
xlabel('time');
ylabel('Amplitude');
title('R.H.S');
```

Output-

COMMAND WINDOW

```
Enter input sequence x1:
[2 3 4]
Enter shift:
3
system is time variant
>>
```



Code-5(when system is non-causal)

```
clc;
clear all;
close all;
%Properties of DT Systems(Causality)
%y(n)=x(-n);
x1=input('Enter input sequence x1:');
n1=input('Enter lower limit n1:');
n2=input('Enter lower limit n2:');
flag=0;
for n=n1:n2
arg=-n;
if arg>n;
flag=1;
end;
end;
if(flag==1)
disp('system is causal');
else
disp('system is non-causal');
end;
```

Output-

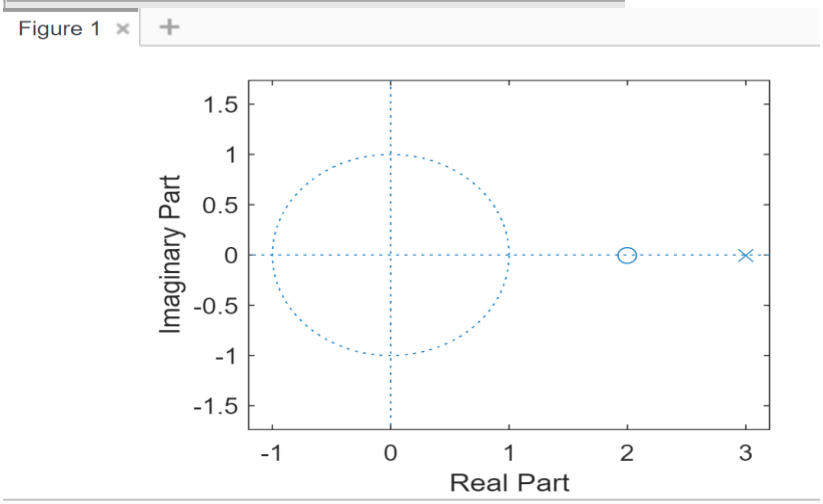
```
COMMAND WINDOW
Enter input sequence x1:
[1 2 3 4]
Enter lower limit n1:
2
Enter lower limit n2:
3
system is non-causal
>>
```

Code-6(when system is unstable)

```
%check stability of system

disp('stability');
nr=input('input the numerator coefficients:');
dr=input('input the denominator coefficients:');
z=tf(nr,dr,1);
[r,p,k]=residuez(nr,dr);
figure
zplane(nr,dr);
if abs(p)<1
disp('the system is stable');
else
disp('the system is unstable');
end;
```

Output-

```
>> dsp3part6
stability
input the numerator coefficients:
2
input the denominator coefficients:
3
the system is unstable
>>
```



Result- The properties of Discrete – Time system is verified using MATLAB Script.