

Scilab Manual for
Digital Signal Processing
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May 18, 2026

¹Funded by a grant from the National Mission on Education through ICT, <http://spoken-tutorial.org/NMEICT-Intro>. This Scilab Manual and Scilab codes written in it can be downloaded from the "Migrated Labs" section at the website <http://scilab.in>

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Experiment: 1

Sampled sinusoidal signal, various sequences and different arithmetic operations

Scilab code Solution 1.1 1

```
1 //Example 1_1
2 //Plot the continuous time signal  $x(t)=\exp(-2t)$  and
   also its discrete time equivalent signal with a
   sampling period  $T = 0.2\text{sec}$ 
3 clear;
4 clc ;
5 close ;
6 t=0:0.01:2;
7 x1=exp(-2*t);
8 subplot(1,2,1);
9 plot(t,x1);
10 xlabel('t ->');
11 ylabel('x(t) ->');
12 title('Continuous-time Plot of  $\exp(-2t)$ ');
13 n=0:0.2:2;
```

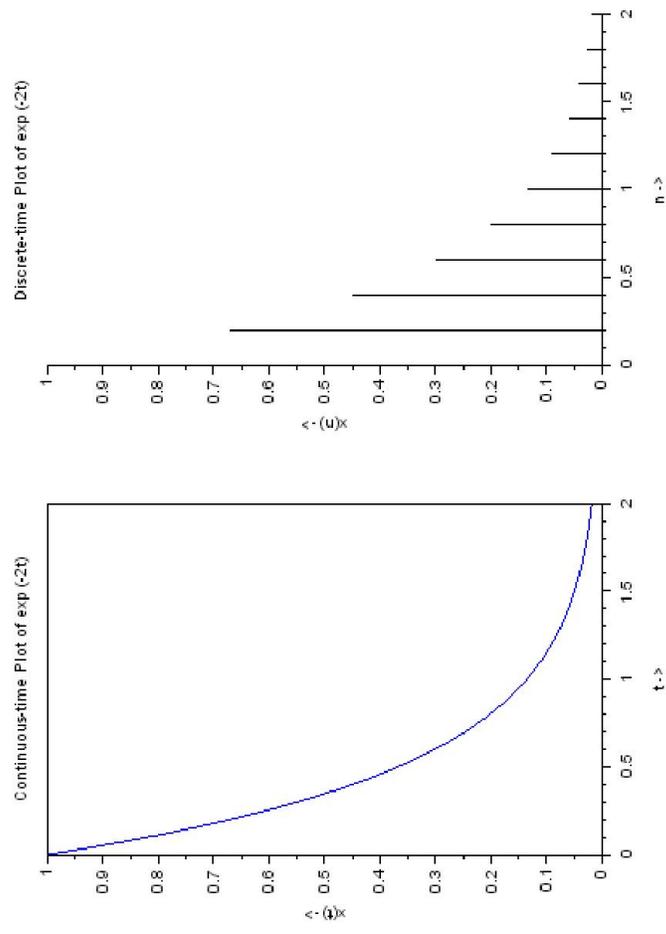


Figure 1.1: 1

```
14 x2=exp(-2*n);
15 subplot(1,2,2);
16 plot2d3(n,x2);
17 xlabel('n ->');
18 ylabel('x(n) ->');
19 title('Discrete-time Plot of exp (-2t)');
```

Scilab code Solution 1.2 2

```
1 //Example 1_2
2 //Plot the continuous time signal x=sin(10*t) and
   also its discrete time equivalent signal with a
   sampling period T = 0.2sec
3 clear;
4 clc ;
5 close ;
6 t=0:0.01:2;
7 x1=sin(10*t);
8 subplot(1,2,1);
9 plot(t,x1);
10 xlabel('t ->');
11 ylabel('x(t) ->');
12 title('Continuous-time Plot of sin (10*t)');
13 n=0:0.2:2;
14 x2=sin(10*n);
15 subplot(1,2,2);
16 plot2d3(n,x2);
17 xlabel('n ->');
18 ylabel('x(n) ->');
19 title('Discrete-time Plot of sin (10*t)');
```

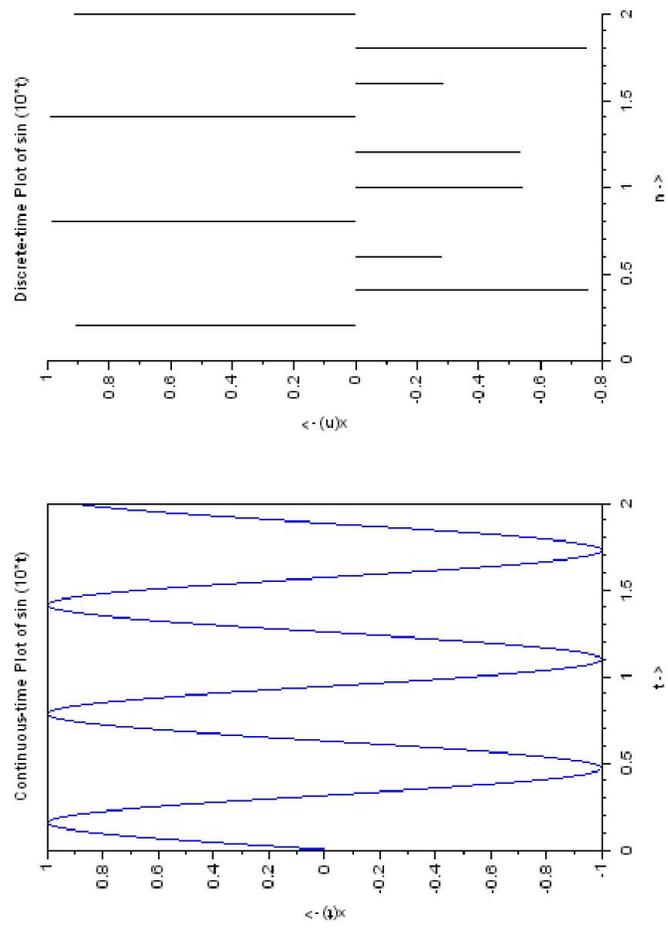


Figure 1.2: 2

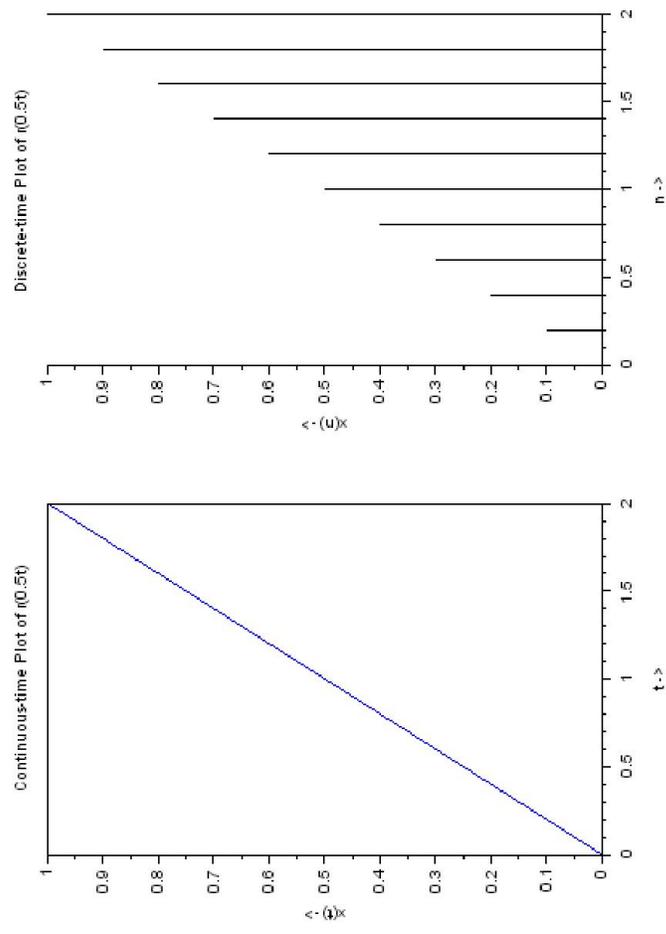


Figure 1.3: 3

Scilab code Solution 1.3 3

```
1 //Example 1_3: Plot the continuous time signal x(t)=
   r(0.5*t) and also its discrete time equivalent
   signal with a sampling period T = 0.2sec
2
3 clc; clear;
4 t=0:0.01:2;
5 x1=0.5*t;
6 subplot(1,2,1);
7 plot(t,x1);
8 xlabel('t ->');
9 ylabel('x(t) ->');
10 title('Continuous-time Plot of r(0.5t)');
11 //zoom_rect([-5 0 5 5]);
12 n=0:0.2:2;
13 x2=0.5*n;
14 subplot(1,2,2);
15 plot2d3(n,x2);
16 xlabel('n ->');
17 ylabel('x(n) ->');
18 title('Discrete-time Plot of r(0.5t)');
```

Scilab code Solution 1.4 4

```
1 //Example 1_4: Plot the continuous time signal x(t)=
   rect(2*t) and also its discrete time equivalent
   signal with a sampling period T = 0.01sec
2 clc;
3 clear;
```

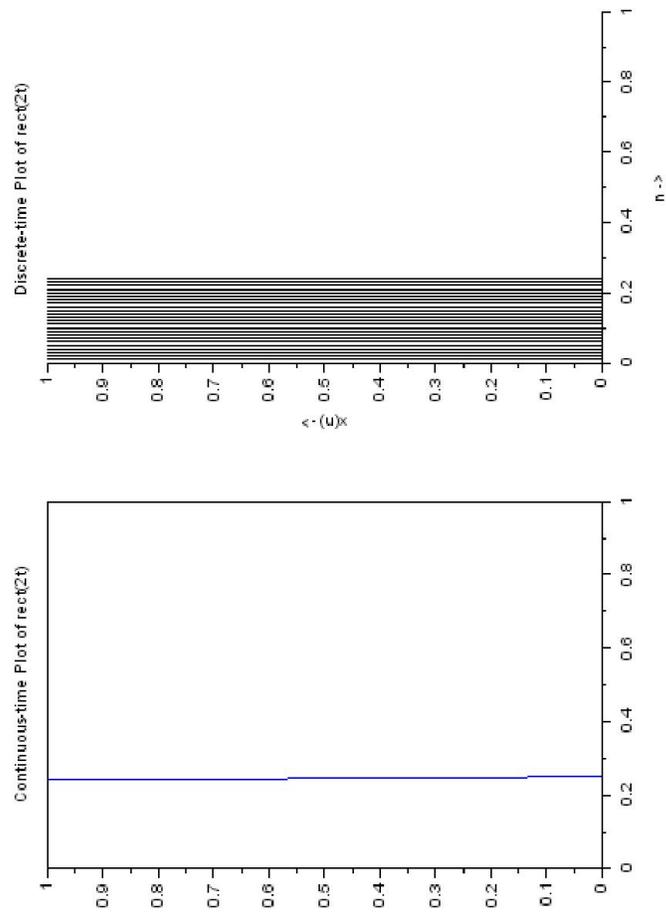


Figure 1.4: 4

```

4 t=0:0.01:1;
5 x1=1*(abs(2*t)<0.5);
6 subplot(1,2,1);
7 plot(t,x1);
8 title('Continuous-time Plot of rect(2t)');
9 n=0:0.01:1;
10 x2=1*(abs(2*n)<0.5);
11 subplot(1,2,2);
12 plot2d3(n,x2);
13 xlabel('n ->');
14 ylabel('x(n) ->');
15 title('Discrete-time Plot of rect(2t)');

```

Scilab code Solution 1.5 5

```

1 //Program 1_5: Plot the continuous time signal x=
   sinc(10*t) and also its discrete time equivalent
   signal with a sampling period T = 0.1sec
2 clear;
3 clc ;
4 close ;
5 t=-2:0.01:2;
6 x1=sinc(10*t);
7 subplot(1,2,1);
8 plot(t,x1);
9 xlabel('t ->');
10 ylabel('x(t) ->');
11 title('Continuous-time Plot of sinc (10*t)');
12 n=-2:0.1:2;
13 x2=sinc(10*n);
14 subplot(1,2,2);
15 plot2d3(n,x2);
16 xlabel('n ->');

```

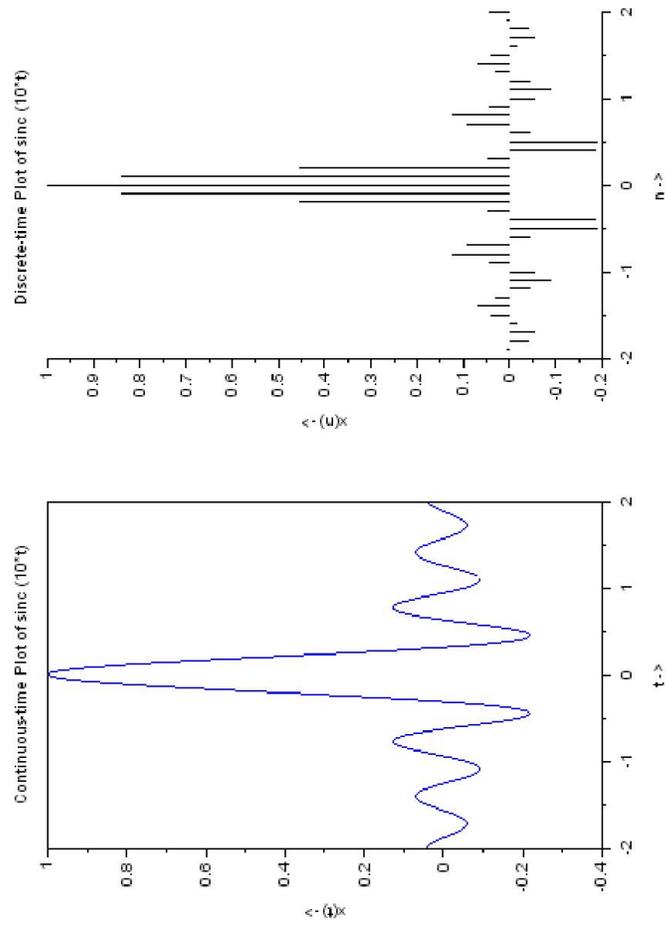


Figure 1.5: 5

```
17 ylabel('x(n) ->');
18 title('Discrete-time Plot of sinc (10*t)');
```

Scilab code Solution 1.6 6

```
1 //program 1_6:Write a Scilab program to verify the
   Time Shifting arithmetic operations of the
   discrete-time sequence x[n]=[1 2 5 3 6]
2
3 clear;
4 clc;
5 close;
6 n=-3:3;
7 x=[0 1 2 5 3 6 0];
8 m=input('Enter the value of m = ');
9 subplot(3,1,1);
10 plot2d3(n,x);
11 xlabel('n ->');
12 ylabel('x(n) ->');
13 title('Discrete-time sequences');
14 subplot(3,1,2);
15 plot2d3(n+(-m),x);
16 xlabel('n ->');
17 ylabel('x(n+m) ->');
18 title('Advance-time sequences (Left shift)');
19 subplot(3,1,3);
20 plot2d3(n-(-m),x);
21 xlabel('n ->');
22 ylabel('x(n-m) ->');
23 title('Delay-time sequences (Right shift)');
```

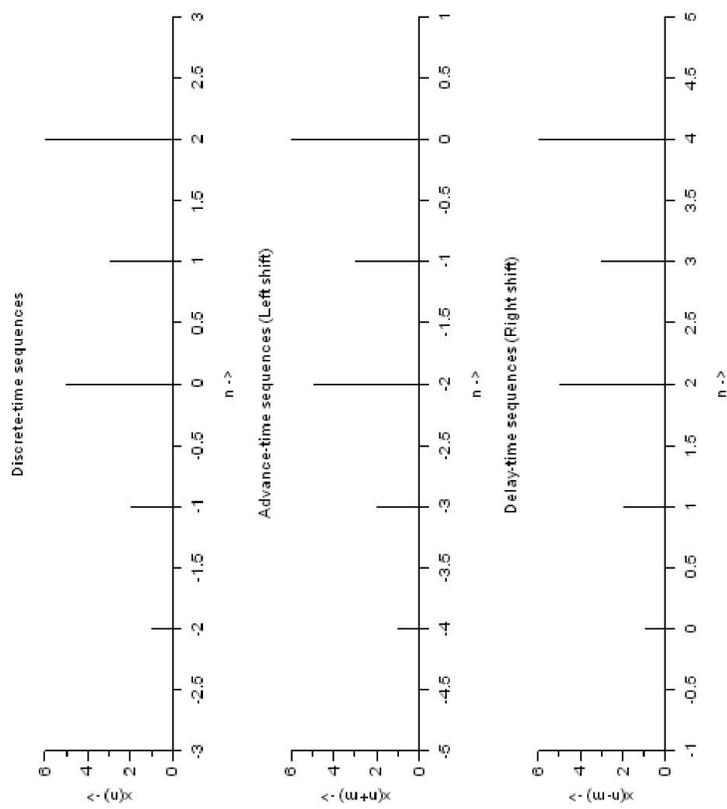


Figure 1.6: 6

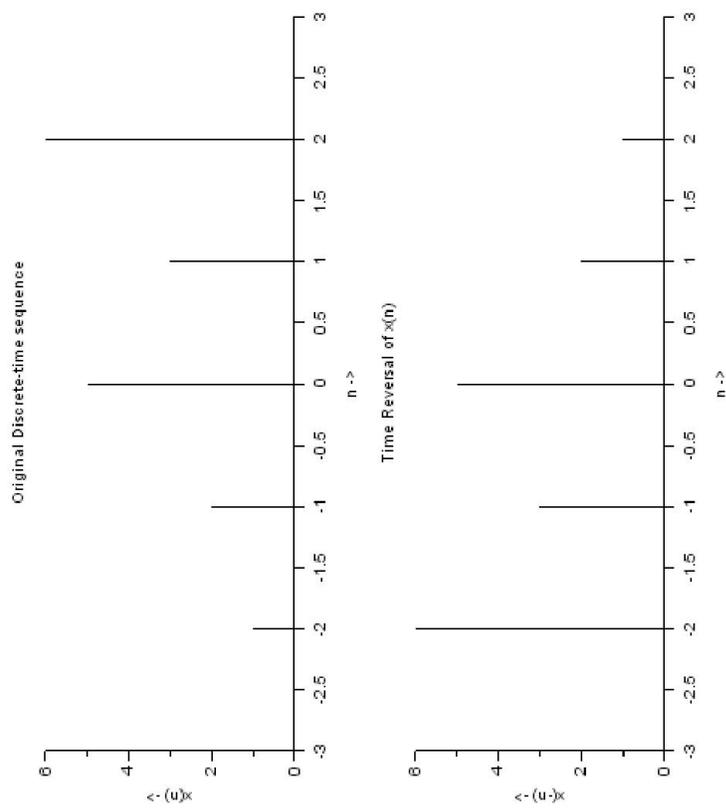


Figure 1.7: 7

Scilab code Solution 1.7 7

```
1 //Program 1_7: Write a Scilab program to verify the
   Time Reversal/Folding arithmetic operations of
   the discrete-time sequence  $x[n]=[1\ 2\ 5\ 3\ 6]$ 
2
3 clear;
4 clc;
5 close;
6 n=-3:3;
7 x=[0 1 2 5 3 6 0];
8 subplot(2,1,1);
9 plot2d3(n,x);
10 xlabel('n ->');
11 ylabel('x(n) ->');
12 title('Original Discrete-time sequence');
13 subplot(2,1,2);
14 plot2d3(-n,x);
15 xlabel('n ->');
16 ylabel('x(-n) ->');
17 title('Time Reversal of x(n)');
```

Scilab code Solution 1.8 8

```
1 //Program 1_8: Write a Scilab program to verify the
   time scaling operations of the discrete-time
   sequence  $x[n]=[1\ 2\ 3\ 4\ 5\ 6]$ 
2
3 clear;
4 clc;
```

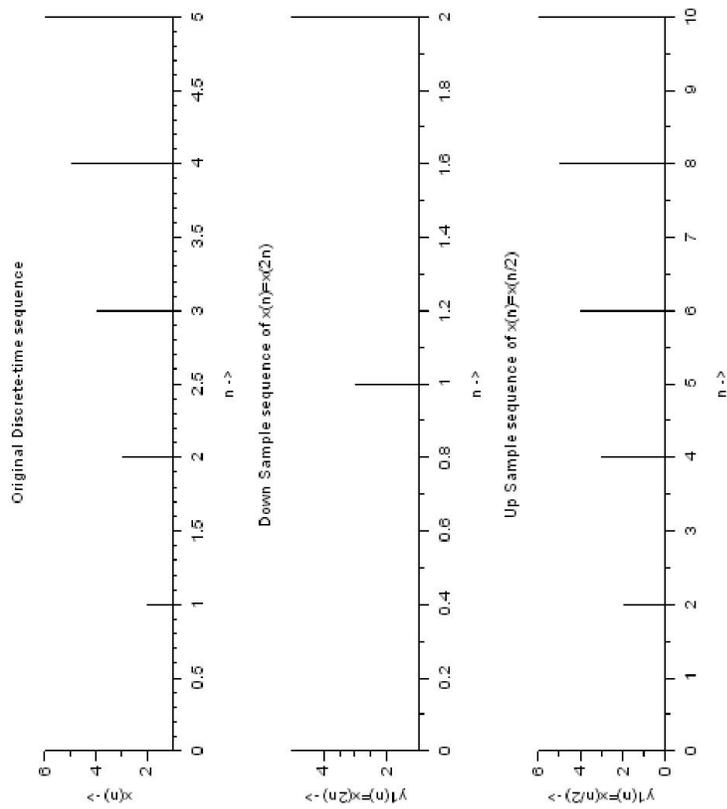


Figure 1.8: 8

```

5  close;
6  n=0:5;
7  x=[1 2 3 4 5 6];
8  subplot(3,1,1);
9  plot2d3(n,x)
10 xlabel('n ->');
11 ylabel('x(n) ->');
12 title('Original Discrete-time sequence');
13 a=2;
14 m=length(n);
15 //Down Sample
16 n1=0:(m/2)-1;
17 y1=[x(1), x(1+(a)), x(1+2*(a))];
18 subplot(3,1,2)
19 plot2d3(n1,y1);
20 xlabel('n ->');
21 ylabel('y1(n)=x(2n) ->');
22 title('Down Sample sequence of x(n)=x(2n)');
23 //Up Sample
24 n2=0:2*(m-1);
25 y2=[x(1), 0, x(2), 0, x(3), 0, x(4), 0, x(5), 0, x
      (6)];
26 subplot(3,1,3);
27 plot2d3(n2,y2)
28 xlabel('n ->');
29 ylabel('y1(n)=x(n/2) ->');
30 title('Up Sample sequence of x(n)=x(n/2)');

```

Scilab code Solution 1.9 9

```

1 //program 1_9: Write a Scilab program to verify the
  Addition or Multiplication operations of the
  discrete-time sequences  $x_1[n]=[0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6]$  and

```

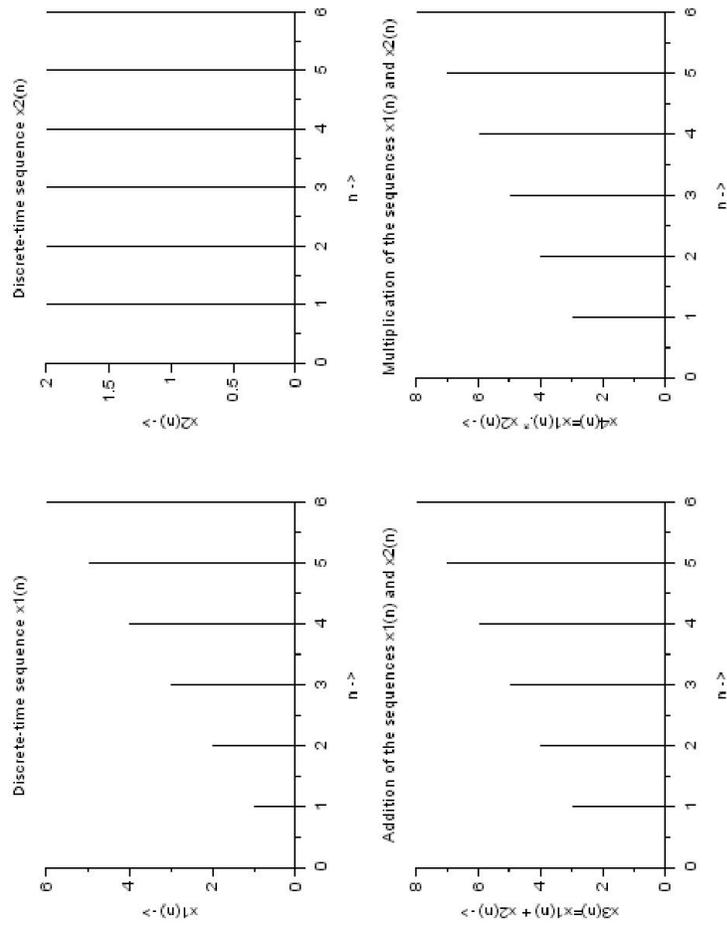


Figure 1.9: 9

```

        x2[n]=[0 2 2 2 2 2 2]
2
3 clear;
4 clc;
5 close;
6 n=0:6;
7 x1=[0 1 2 3 4 5 6];
8 x2=[0 2 2 2 2 2 2];
9 subplot(2,2,1);
10 plot2d3(n,x1);
11 xlabel('n ->');
12 ylabel('x1(n) ->');
13 title('Discrete-time sequence x1(n)');
14 subplot(2,2,2);
15 plot2d3(n,x2);
16 xlabel('n ->');
17 ylabel('x2(n) ->');
18 title('Discrete-time sequence x2(n)');
19 x3=x1+x2;
20 subplot(2,2,3);
21 plot2d3(n,x3);
22 xlabel('n ->');
23 ylabel('x3(n)=x1(n) + x2(n) ->');
24 title('Addition of the sequences x1(n) and x2(n)');
25 x4=x1.*x2;
26 subplot(2,2,4);
27 plot2d3(n,x4);
28 xlabel('n ->');
29 ylabel('x4(n)=x1(n).* x2(n) ->');
30 title('Multiplication of the sequences x1(n) and x2(
    n)');

```

Experiment: 2

Convolution of two sequences using graphical methods and using commands

Scilab code Solution 2.1 1

```
1 //Part1_Convolution of two sequences x1[n] & x2[n]
2 clear;
3 clc;
4 close;
5 n1=0:4;
6 x1=[1 2 0.5 1 2];
7 subplot(2,2,1);
8 plot2d3(n1,x1);
9 xlabel('n ->');
10 ylabel('x1[n] ->');
11 title('Discrete-time sequences x1[n]');
12 n2=-1:3;
13 x2=[1 2 1 -1 2];
14 subplot(2,2,2);
15 plot2d3(n2,x2);
```

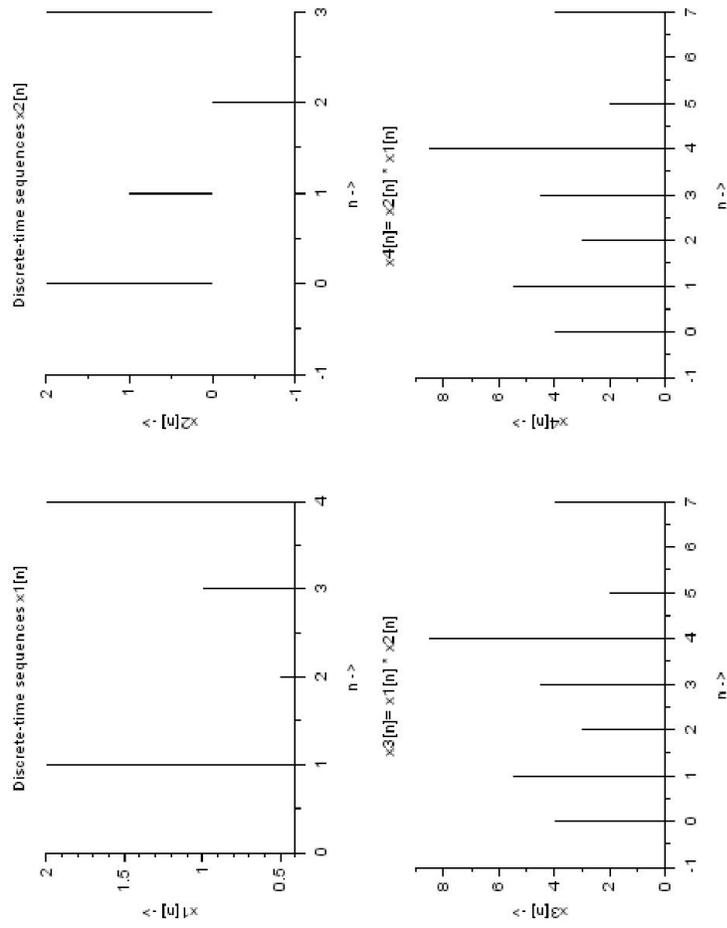


Figure 2.1: 1

```

16 xlabel('n ->');
17 ylabel('x2[n] ->');
18 title('Discrete-time sequences x2[n]');
19 //Verification of Commutative Property
20 n3=-1:7;
21 x3=convol(x1,x2)
22 x4=convol(x2,x1)
23 subplot(2,2,3);
24 plot2d3(n3,x3)
25 xlabel('n ->');
26 ylabel('x3[n] ->');
27 title('x3[n]= x1[n] * x2[n]');
28 subplot(2,2,4);
29 plot2d3(n3, x4);
30 xlabel('n ->');
31 ylabel('x4[n] ->');
32 title('x4[n]= x2[n] * x1[n]');

```

Scilab code Solution 2.2 2

```

1 //Program 2_Verifivation of Distributive Property of
  Convolution
2 clear;
3 clc;
4 close;
5 n1=0:4;
6 x1=[1 2 0.5 1 2];
7 subplot(2,3,1);
8 plot2d3(n1,x1);
9 xlabel('n ->');
10 ylabel('x1[n] ->');
11 title('Discrete-time sequences x1[n]');
12 n2=-1:3;

```

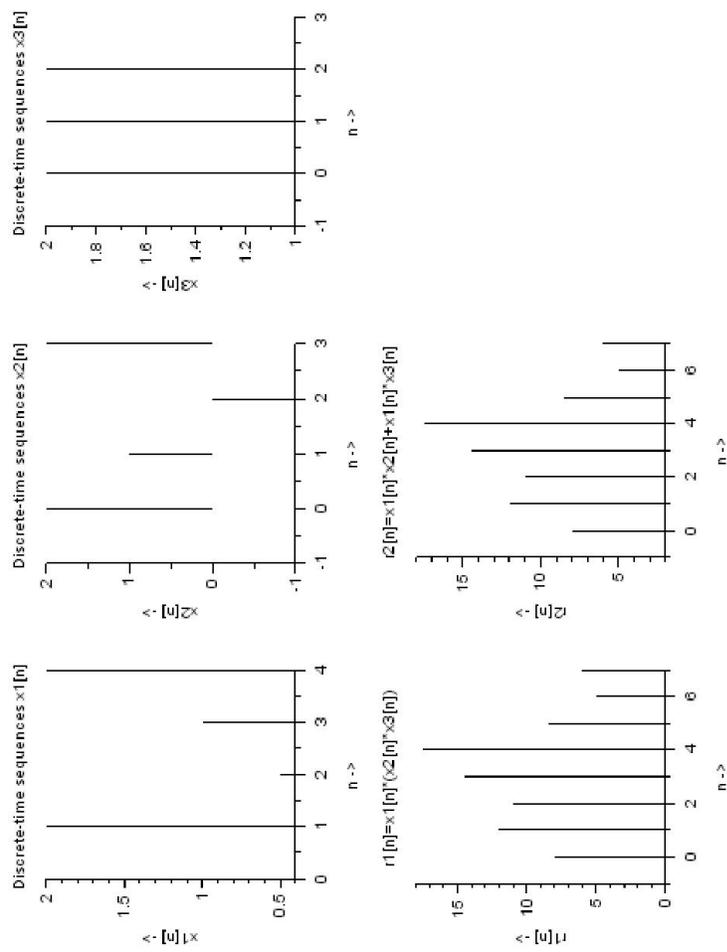


Figure 2.2: 2

```

13 x2=[1 2 1 -1 2];
14 subplot(2,3,2);
15 plot2d3(n2,x2);
16 xlabel('n ->');
17 ylabel('x2[n] ->');
18 title('Discrete-time sequences x2[n]');
19 n3=-1:3;
20 x3=[1 2 2 2 1];
21 subplot(2,3,3);
22 plot2d3(n3,x3);
23 xlabel('n ->');
24 ylabel('x3[n] ->');
25 title('Discrete-time sequences x3[n]');
26 //Verification of Distributive Property
27 s1=-1:7;
28 x4=x2+x3;
29 r1=convol(x1,x4);
30 subplot(2,3,4);
31 plot2d3(s1,r1);
32 xlabel('n ->');
33 ylabel('r1[n] ->');
34 title('r1[n]=x1[n]*(x2[n]*x3[n])');
35 x4=convol(x1,x2);
36 x5=convol(x1,x3);
37 r2=x4+x5;
38 subplot(2,3,5);
39 plot2d3(s1,r2);
40 xlabel('n ->');
41 ylabel('r2[n] ->');
42 title('r2[n]=x1[n]*x2[n]+x1[n]*x3[n]');

```

Scilab code Solution 2.3 3

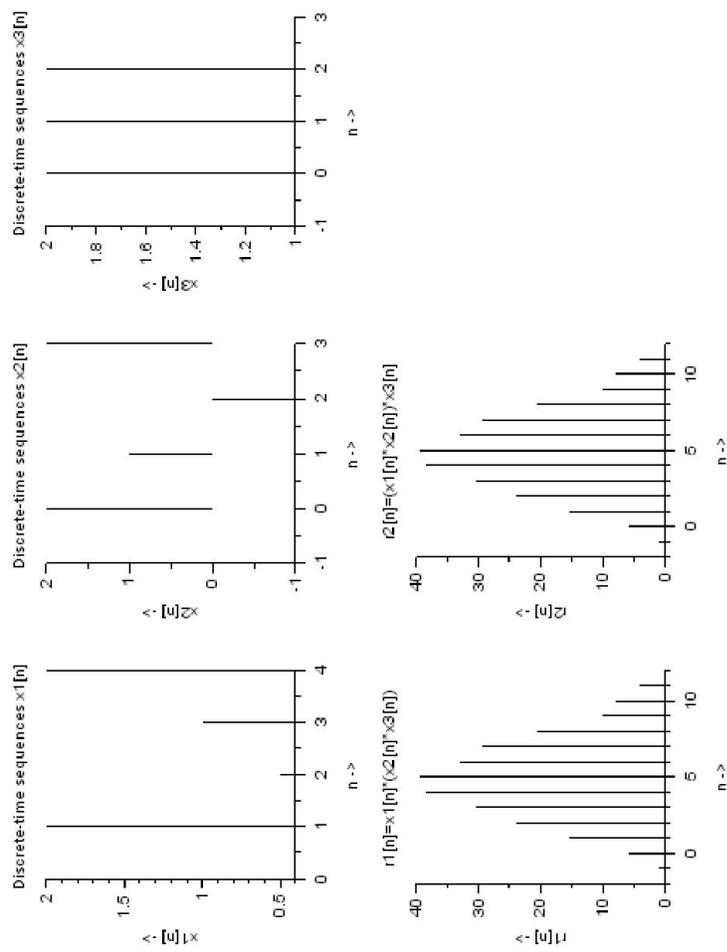


Figure 2.3: 3

```

1 //Program 3_Verifivation of Associative Property of
  Convolution
2 clear;
3 clc;
4 close;
5 n1=0:4;
6 x1=[1 2 0.5 1 2];
7 subplot(2,3,1);
8 plot2d3(n1,x1);
9 xlabel('n ->');
10 ylabel('x1[n] ->');
11 title('Discrete-time sequences x1[n]');
12 n2=-1:3;
13 x2=[1 2 1 -1 2];
14 subplot(2,3,2);
15 plot2d3(n2,x2);
16 xlabel('n ->');
17 ylabel('x2[n] ->');
18 title('Discrete-time sequences x2[n]');
19 n3=-1:3;
20 x3=[1 2 2 2 1];
21 subplot(2,3,3);
22 plot2d3(n3,x3);
23 xlabel('n ->');
24 ylabel('x3[n] ->');
25 title('Discrete-time sequences x3[n]');
26 //Verification of Associative Property
27 s1=-1:11;
28 r1=convol(x1,convol(x2,x3));
29 subplot(2,3,4);
30 plot2d3(s1,r1);
31 xlabel('n ->');
32 ylabel('r1[n] ->');
33 title('r1[n]=x1[n]*(x2[n]*x3[n])');
34 r2=convol(convol(x1,x2),x3);
35 subplot(2,3,5);
36 plot2d3(s1,r2);
37 xlabel('n ->');

```

```
38 ylabel('r2[n] ->');  
39 title('r2[n]=(x1[n]*x2[n])*x3[n]');
```

Experiment: 3

verification of the properties of convolution

Scilab code Solution 3.1 1

```
1 //Part1_Convolution of two sequences x1[n] & x2[n]
2 clear;
3 clc;
4 close;
5 n1=0:4;
6 x1=[1 2 0.5 1 2];
7 subplot(2,2,1);
8 plot2d3(n1,x1);
9 xlabel('n ->');
10 ylabel('x1[n] ->');
11 title('Discrete-time sequences x1[n]');
12 n2=-1:3;
13 x2=[1 2 1 -1 2];
14 subplot(2,2,2);
15 plot2d3(n2,x2);
16 xlabel('n ->');
17 ylabel('x2[n] ->');
```

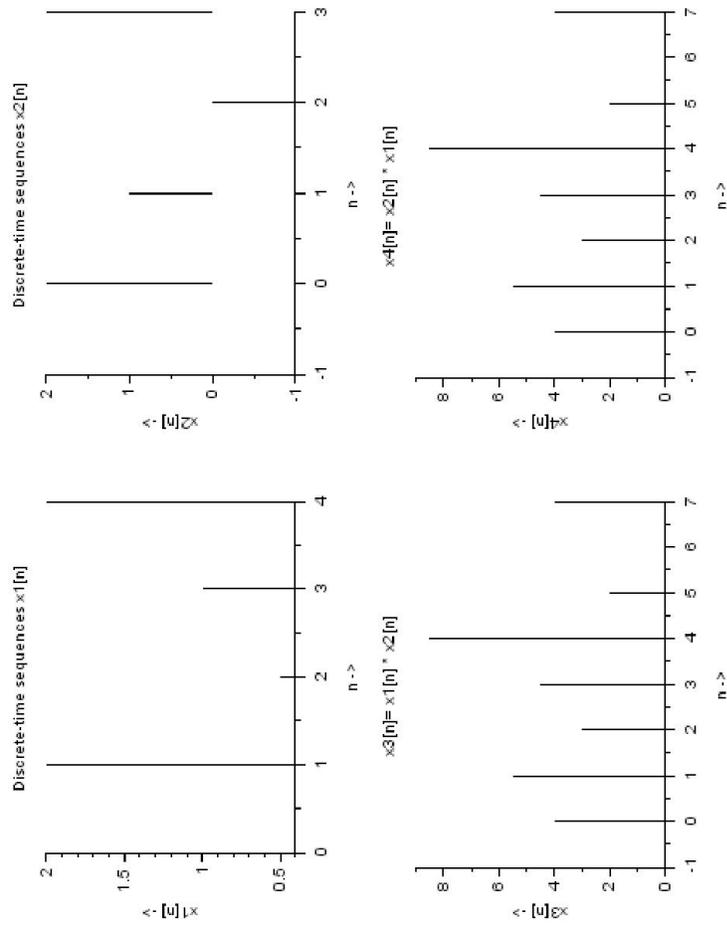


Figure 3.1: 1

```

18 title('Discrete-time sequences x2[n]');
19 //Verification of Commutative Property
20 n3=-1:7;
21 x3=convol(x1,x2)
22 x4=convol(x2,x1)
23 subplot(2,2,3);
24 plot2d3(n3,x3)
25 xlabel('n ->');
26 ylabel('x3[n] ->');
27 title('x3[n]= x1[n] * x2[n]');
28 subplot(2,2,4);
29 plot2d3(n3, x4);
30 xlabel('n ->');
31 ylabel('x4[n] ->');
32 title('x4[n]= x2[n] * x1[n]');

```

Scilab code Solution 3.2 2

```

1 //Program 2_Verifivation of Distributive Property of
  Convolution
2 clear;
3 clc;
4 close;
5 n1=0:4;
6 x1=[1 2 0.5 1 2];
7 subplot(2,3,1);
8 plot2d3(n1,x1);
9 xlabel('n ->');
10 ylabel('x1[n] ->');
11 title('Discrete-time sequences x1[n]');
12 n2=-1:3;
13 x2=[1 2 1 -1 2];
14 subplot(2,3,2);

```

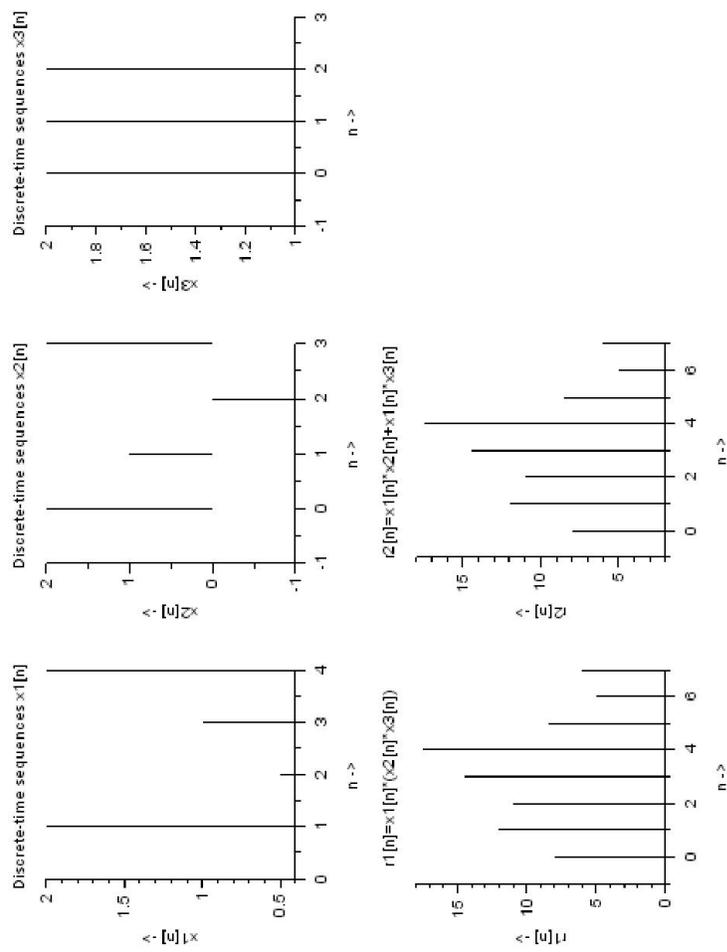


Figure 3.2: 2

```

15 plot2d3(n2,x2);
16 xlabel('n ->');
17 ylabel('x2[n] ->');
18 title('Discrete-time sequences x2[n]');
19 n3=-1:3;
20 x3=[1 2 2 2 1];
21 subplot(2,3,3);
22 plot2d3(n3,x3);
23 xlabel('n ->');
24 ylabel('x3[n] ->');
25 title('Discrete-time sequences x3[n]');
26 //Verification of Distributive Property
27 s1=-1:7;
28 x4=x2+x3;
29 r1=convol(x1,x4);
30 subplot(2,3,4);
31 plot2d3(s1,r1);
32 xlabel('n ->');
33 ylabel('r1[n] ->');
34 title('r1[n]=x1[n]*(x2[n]*x3[n])');
35 x4=convol(x1,x2);
36 x5=convol(x1,x3);
37 r2=x4+x5;
38 subplot(2,3,5);
39 plot2d3(s1,r2);
40 xlabel('n ->');
41 ylabel('r2[n] ->');
42 title('r2[n]=x1[n]*x2[n]+x1[n]*x3[n]');

```

Scilab code Solution 3.3 3

```

1 //Program 3-Verifivation of Associative Property of
  Convolution

```

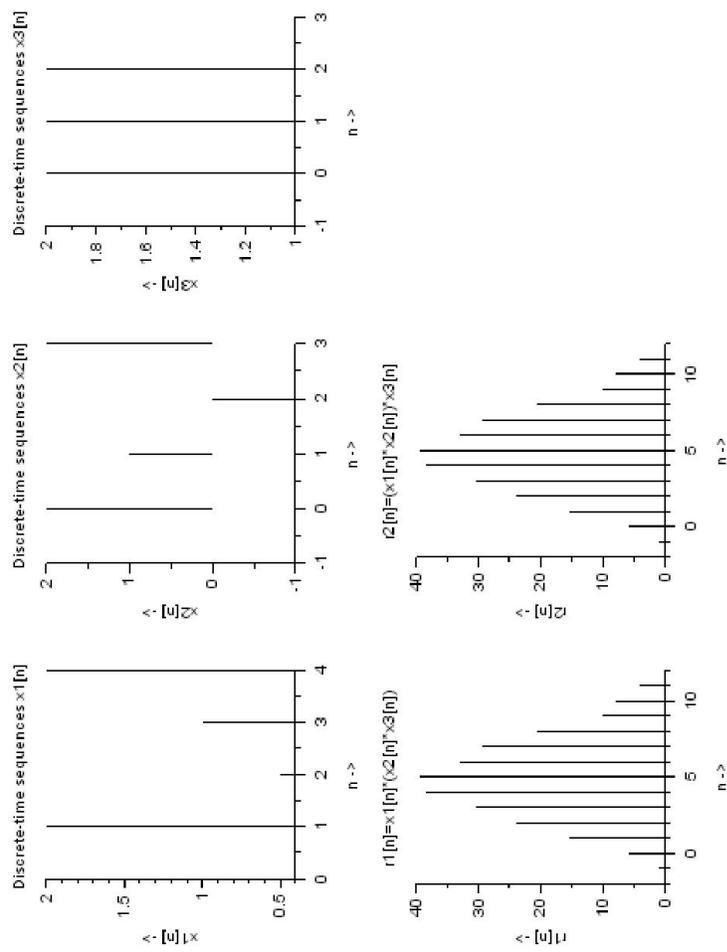


Figure 3.3: 3

```

2 clear;
3 clc;
4 close;
5 n1=0:4;
6 x1=[1 2 0.5 1 2];
7 subplot(2,3,1);
8 plot2d3(n1,x1);
9 xlabel('n ->');
10 ylabel('x1[n] ->');
11 title('Discrete-time sequences x1[n]');
12 n2=-1:3;
13 x2=[1 2 1 -1 2];
14 subplot(2,3,2);
15 plot2d3(n2,x2);
16 xlabel('n ->');
17 ylabel('x2[n] ->');
18 title('Discrete-time sequences x2[n]');
19 n3=-1:3;
20 x3=[1 2 2 2 1];
21 subplot(2,3,3);
22 plot2d3(n3,x3);
23 xlabel('n ->');
24 ylabel('x3[n] ->');
25 title('Discrete-time sequences x3[n]');
26 //Verification of Associative Property
27 s1=-1:11;
28 r1=convol(x1,convol(x2,x3));
29 subplot(2,3,4);
30 plot2d3(s1,r1);
31 xlabel('n ->');
32 ylabel('r1[n] ->');
33 title('r1[n]=x1[n]*(x2[n]*x3[n])');
34 r2=convol(convol(x1,x2),x3);
35 subplot(2,3,5);
36 plot2d3(s1,r2);
37 xlabel('n ->');
38 ylabel('r2[n] ->');
39 title('r2[n]=(x1[n]*x2[n])*x3[n]');

```


Experiment: 4

Z-transform of various sequences

Scilab code Solution 4.1 1

```
1 //Program 1:1. Write a Scilab program to determine
   z-transform of the following finite duration
   signal x[n]=[2 4 5 7 0 1]
2
3 x=[2 4 5 7 0 1];
4 p=0;
5 n=-2;
6 for i=1:6
7     p=p+x(i)*%z^(-n);
8     n=n+1;
9 end;
10 disp(p);
```

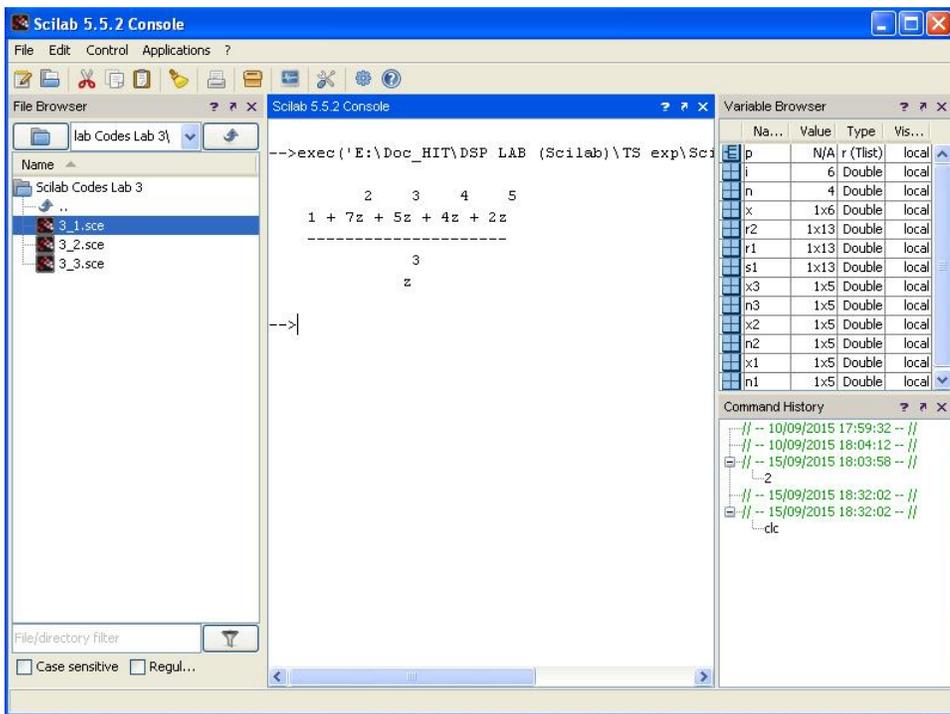


Figure 4.1: 1

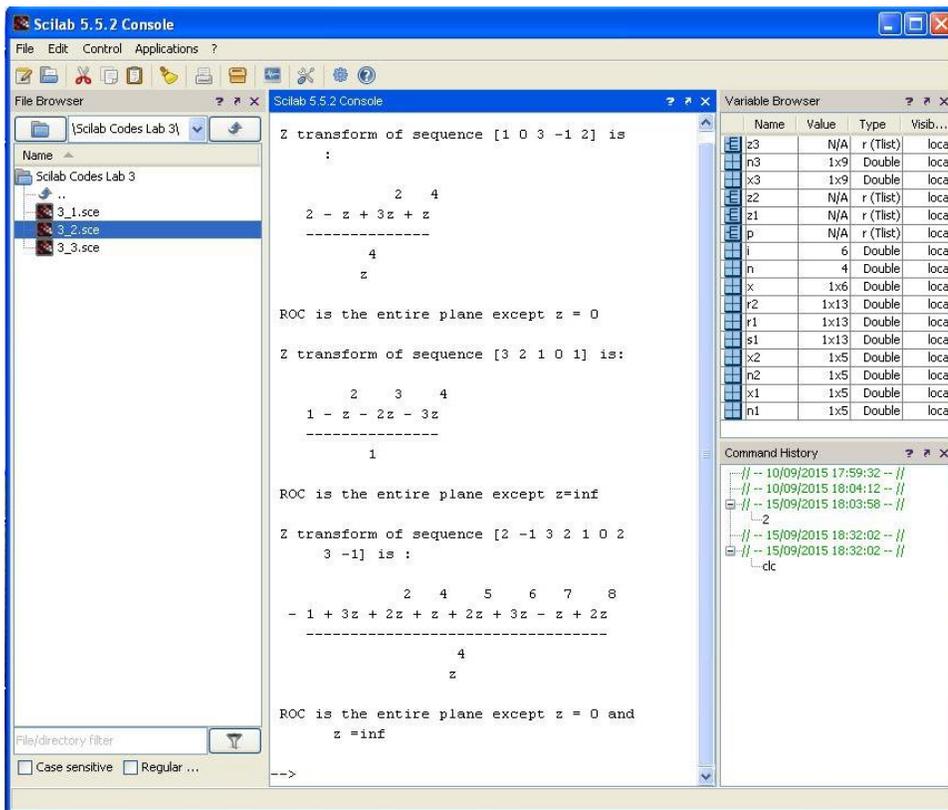


Figure 4.2: 2

Scilab code Solution 4.2 2

```
1 //Program 2_Z transform of Causal, Anticausal and
   Noncausal sequence
2 clear all;
3 clc ;
4 close ;
5 function [za ]= ztransfer ( sequence ,n)
6 za= sequence *(1/ %z)^n'
7 endfunction
8 //z transform of [1 0 3 -1 2]
9 x1 =[1 0 3 -1 2];
10 n1=0:length (x1)-1;
11 z1= ztransfer (x1,n1);
12 disp (z1 ,"Z transform of sequence [1 0 3 -1 2] is :
   ");
13 disp ( 'ROC is the entire plane except z = 0 ' );
14
15 //Z transform of [3 2 1 0 1]
16 x2 =[-3 -2 -1 0 1];
17 n2=- (length(x2)-1):0;
18 z2= ztransfer(x2,n2);
19 disp(z2 ,"Z transform of sequence [3 2 1 0 1] is: ")
   ;
20 disp('ROC is the entire plane except z=inf' );
21
22 //Z transform of [2 -1 3 2 1 0 2 3 -1]
23 x3 =[2 -1 3 2 1 0 2 3 -1];
24 n3= -4:4;
25 z3= ztransfer(x3,n3);
26 disp(z3,"Z transform of sequence [2 -1 3 2 1 0 2 3
   -1] is : ");
27 disp('ROC is the entire plane except z = 0 and z =
   inf' );
```
