Scilab Manual for DIGITAL SIGNAL PROCESSING & PROCESSORS

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Experiment: 1

Compute Four Point DFT Using Matrix Approach Only.

Scilab code Solution 1.0 Experiment Number 1

```
1  // AIM:Compute four point DFT using matrix approach
       only.
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6
7  //Let x(n)={1,2,3,4}
8  //Let us first define the W4 matrix
9  W4=[1 1 1 1 ;1 -sqrt(-1) -1 sqrt(-1);1 -1 1 -1;1
       sqrt(-1) -1 -sqrt(-1)];
10 disp(W4,'W4=')
11 //Now let us define the input sequence
12 xn=[1;2;3;4];//The input sequence x(n)has been
       arranged as a column matrix
13 //DFT is obtained by multiplying the twiddle matrix
       W4 and the input sequence
14 Xk=W4*xn;
15 disp(Xk,'DFT : X(k)=')
```

Experiment: 2

Derive The [W4*] Matrix Useful To Compute IDFT

Scilab code Solution 2.0 Experiment Number 2

```
1  //AIM: Derive the [W4*] matrix useful to compute
       IDFT.
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6  W40_star=int(cos(0))+(sqrt(-1)*int(sin(0)));
7  W41_star=int(cos(%pi/2))+(sqrt(-1))*int((sin(%pi/2))
       );
8  W42_star=int(cos(%pi))+(sqrt(-1))*int((sin(%pi)));
9  W43_star=int(cos((3*%pi)/2))+(sqrt(-1))*int(sin((3*
       %pi)/2));
10
11 disp(W40_star,'W40_star=')
12 disp(W41_star,'W41_star=')
13 disp(W42_star,'W42_star=')
14 disp(W43_star,'W43_star=')
15
16 W44_star=W40_star;
```

```
17 W49_star=W41_star;
18 W46_star=W42_star;
19
20 W4_star= [W40_star W40_star W40_star W40_star;
21           W40_star W41_star W42_star W43_star;
22           W40_star W42_star W44_star W46_star;
23           W40_star W43_star W46_star W49_star];
24 disp(W4_star,'W4_star=')
```

Experiment: 3

IDFT Computation Using Matrix Method

Scilab code Solution 3.0 Experiment Number 3

```
1  //AIM:IDFT computation using matrix method.
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6
7  //Let Y(k)={1,0,1,0}
8  //Computation for Inverse Discrete Fourier Transform
       (IDFT)
9  //Let us first define the W4* matrix
10 W4_star=[1 1 1 1 ;1 sqrt(-1) -1 -sqrt(-1);1 -1 1
       -1;1 -sqrt(-1) -1 sqrt(-1)];
11 disp(W4_star,'W4*=')
12 Yk=[1;0;1;0];//The input sequence Y(k) has been
       arranged as a column matrix
13 yn=(1/4)*W4_star*Yk;
14 disp(yn,'IDFT : y(n)=')
```

Experiment: 4

N=8; DIT-FFT Without Using Inbuilt Scilab FFT Function

Scilab code Solution 4.0 Experiment Number 4

```
1  //AIM: N=8; DIT-FFT without using inbuilt Scilab FFT
       function
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6  //Let x(n)={1,2,1,2,0,2,1,2}
7  //Let us begin with the programming.For
       understanding,let us write the given data as
8  //x(0)=1;x(1)=2,x(2)=1,x(3)=2,x(4)=0,x(5)=2,x(6)=1,x
       (7)=2
9  x0=1;//DIT-FFT,so arranging the input in bit-
       reversed order
10 x4=0;//DIT-FFT,so arranging the input in bit-
       reversed order
11 x2=1;//DIT-FFT,so arranging the input in bit-
       reversed order
12 x6=1;//DIT-FFT,so arranging the input in bit-
       reversed order
```

```
13 x1=2;//DIT-FFT,so arranging the input in bit-
     reversed order
14 x5=2;//DIT-FFT,so arranging the input in bit-
     reversed order
15 x3=2;//DIT-FFT,so arranging the input in bit-
     reversed order
16 x7=2;//DIT-FFT,so arranging the input in bit-
     reversed order
17 //Stage I computation
18 x0a=x4+x0;//Computing Stage-I output at line 1
19 disp(x0a,'Stage-I output at line 1=')
20 x4b=(x4-x0)*(-1);//Computing Stage-I output at line
     2
21 disp(x4b,'Stage-I output at line 2=')
22 x2c=x6+x2;//Computing Stage-I output at line 3
23 disp(x2c,'Stage-I output at line 3=')
24 x6d=(x6-x2)*(-1);//Computing Stage-I output at line
     4
25 disp(x6d,'Stage-I output at line 4=')
26 x1e=x5+x1;//Computing Stage-I output at line 5
27 disp(x1e,'Stage-I output at line 5=')
28 x5f=(x5-x1)*(-1);//Computing Stage-I output at line
     6
29 disp(x5f,'Stage-I output at line 6=')
30 x3g=x7+x3;//Computing Stage-I output at line 7
31 disp(x3g,'Stage-I output at line 7')
32 x7h=(x7-x3)*(-1);//Computing Stage-I output at line
     8
33 disp(x7h,'Stage-I output at line 8=')
34
35 //Stage-I output at line 4 and line 8 is to be
     multiplied by twiddle factor having value (-j)
36 x6d1=(x6d)*(-sqrt(-1));
37 x7h1=(x7h)*(-sqrt(-1));
38 disp(x6d1,'Stage-I output(i.e. input to stage-II)
     after multiplication by twiddle factor value of
     (-j) at line 4 =')
39 disp(x7h1,'Stage-I output(i.e. input to stage-II)
```

```
    after multiplication by twiddle factor value of
    (-j) at line 8 =')
40
41 //Stage-II Computations
42 x0a_stageII_output=x2c+x0a;//Computing Stage-II
    output at line 1
43 disp(x0a_stageII_output,'Stage-II output at line 1='
    )
44 x4b_stageII_output=x6d1+x4b;//Computing Stage-II
    output at line 2
45 disp(x4b_stageII_output,'Stage-II output at line 2='
    )
46 x2c_stageII_output=(x2c-x0a)*(-1);//Computing Stage-
    II output at line 3
47 disp(x2c_stageII_output,'Stage-II output at line 3='
    )
48 x6d_stageII_output=(x6d1-x4b)*(-1);//Computing Stage
    -II output at line 4
49 disp(x6d_stageII_output,'Stage-II output at line 4='
    )
50 x1e_stageII_output=x3g+x1e;//Computing Stage-II
    output at line 5
51 disp(x1e_stageII_output,'Stage-II output at line 5='
    )
52 x5f_stageII_output=x7h1+x5f;//Computing Stage-II
    output at line 6
53 disp(x5f_stageII_output,'Stage-II output at line 6='
    )
54 x3g_stageII_output=(x3g-x1e)*(-1);//Computing Stage-
    II output at line 7
55 disp(x3g_stageII_output,'Stage-II output at line 7='
    )
56 x7h_stageII_output=(x7h1-x5f)*(-1);//Computing Stage
    -II output at line 8
57 disp(x7h_stageII_output,'Stage-II output at line 8='
    )
58
59 //Stage-II output at line 6,line 7 and line 8 are to
```

```
      be multiplied by twiddle factor having value
      (0.707-j0.707),(-j) and (-0.707-j0.707)
      respectively
60 x5f_stgII_op_multi_by_tw=(x5f_stageII_output)
      *(0.707-(sqrt(-1))*(0.707));
61 disp(x5f_stgII_op_multi_by_tw,'Stage-II output at
      line 6 after multiplication by twiddle factor=')
62 x3g_stgII_op_multi_by_tw=(x3g_stageII_output)*(-(
      sqrt(-1)));
63 disp(x3g_stgII_op_multi_by_tw,'Stage-II output at
      line 7 after multiplication by twiddle factor=')
64 x7h_stgII_op_multi_by_tw=(x7h_stageII_output)
      *(-0.707-(sqrt(-1))*(0.707));
65 disp(x7h_stgII_op_multi_by_tw,'Stage-II output at
      line 8 after multiplication by twiddle factor=')
66
67 //Stage-III Computations(i.e. Computations for the
      final stage)
68 X0=x1e_stageII_output+x0a_stageII_output;//Computing
       X(0) at last stage
69 X1=x5f_stgII_op_multi_by_tw+x4b_stageII_output;//
      Computing X(1) at last stage
70 X2=x3g_stgII_op_multi_by_tw+x2c_stageII_output;//
      Computing X(2) at last stage
71 X3=x7h_stgII_op_multi_by_tw+x6d_stageII_output;//
      Computing X(3) at last stage
72 X4=(x1e_stageII_output-x0a_stageII_output)*(-1);//
      Computing X(4) at last stage
73 X5=(x5f_stgII_op_multi_by_tw-x4b_stageII_output)
      *(-1);//Computing X(5) at last stage
74 X6=(x3g_stgII_op_multi_by_tw-x2c_stageII_output)
      *(-1);//Computing X(6) at last stage
75 X7=(x7h_stgII_op_multi_by_tw-x6d_stageII_output)
      *(-1);//Computing X(7) at last stage
76 disp(X0,'X(0)=')
77 disp(X1,'X(1)=')
78 disp(X2,'X(2)=')
79 disp(X3,'X(3)=')
```

```
80 disp(X4,'X(4)=')
81 disp(X5,'X(5)=')
82 disp(X6,'X(6)=')
83 disp(X7,'X(7)=')
84 disp({,X0,X1,X2,X3,X4,X5,X6,X7,},'So,the DFT of x(n)
       using Decimation-in-Time Fast Fourier Transform(
     DIT-FFT) is X(k)=')
```

Experiment: 5

N=8; IDIT-FFT Without Using Inbuilt Scilab FFT Function

Scilab code Solution 5.0 Experiment Number 5

```
1 //AIM:N=8; IDIT-FFT without using inbuilt Scilab FFT
    function
2 //Software version Scilab 5.5.2
3 //OS windows 10
4 clc;
5 clear;
6 //Let X(k)={11,1-1,1,-5,1,-1,1}
7 //Let us begin with the programming.For
    understanding,let us write the given data as
8 //X(0)=11;X(1)=1,X(2)=-1,X(3)=1,X(4)=-5,X(5)=1,X(6)
    =-1,X(7)=1
9 X0_conj=11;//IDIT-FFT,so arranging the input in bit-
    reversed order
10 X4_conj=-5;//IDIT-FFT,so arranging the input in bit-
    reversed order
11 X2_conj=-1;//IDIT-FFT,so arranging the input in bit-
    reversed order
12 X6_conj=-1;//IDIT-FFT,so arranging the input in bit-
    reversed order
```

```
13 X1_conj=1;//IDIT-FFT,so arranging the input in bit-
      reversed order
14 X5_conj=1;//IDIT-FFT,so arranging the input in bit-
      reversed order
15 X3_conj=1;//IDIT-FFT,so arranging the input in bit-
      reversed order
16 X7_conj=1;//IDIT-FFT,so arranging the input in bit-
      reversed order
17 disp(X0_conj,'X*(0)=')
18 disp(X4_conj,'X*(4)=')
19 disp(X2_conj,'X*(2)=')
20 disp(X6_conj,'X*(6)=')
21 disp(X1_conj,'X*(1)=')
22 disp(X5_conj,'X*(5)=')
23 disp(X3_conj,'X*(3)=')
24 disp(X7_conj,'X*(7)=')
25 //Stage I computation
26 X0a=X4_conj+X0_conj;//Computing Stage-I output at
      line 1
27 disp(X0a,'Stage-I output at line 1=')
28 X4b=(X4_conj-X0_conj)*(-1);//Computing Stage-I
      output at line 2
29 disp(X4b,'Stage-I output at line 2=')
30 X2c=X6_conj+X2_conj;//Computing Stage-I output at
      line 3
31 disp(X2c,'Stage-I output at line 3=')
32 X6d=(X6_conj-X2_conj)*(-1);//Computing Stage-I
      output at line 4
33 disp(X6d,'Stage-I output at line 4=')
34 X1e=X5_conj+X1_conj;//Computing Stage-I output at
      line 5
35 disp(X1e,'Stage-I output at line 5=')
36 X5f=(X5_conj-X1_conj)*(-1);//Computing Stage-I
      output at line 6
37 disp(X5f,'Stage-I output at line 6=')
38 X3g=X7_conj+X3_conj;//Computing Stage-I output at
      line 7
39 disp(X3g,'Stage-I output at line 7')
```

```
40 X7h=(X7_conj-X3_conj)*(-1);//Computing Stage-I
     output at line 8
41 disp(X7h,'Stage-I output at line 8=')
42
43 //Stage-I output at line 4 and line 8 is to be
     multiplied by twiddle factor having value (-j)
44 X6d'=(X6d)*(-sqrt(-1));
45 X7h'=(X7h)*(-sqrt(-1));
46 disp(X6d','Stage-I output(i.e. input to stage-II)
     after multiplication by twiddle factor value of
     (-j) at line 4 =')
47 disp(X7h','Stage-I output(i.e. input to stage-II)
     after multiplication by twiddle factor value of
     (-j) at line 8 =')
48
49 //Stage-II Computations
50 X0a_stageII_output=X2c+X0a;//Computing Stage-II
     output at line 1
51 disp(X0a_stageII_output,'Stage-II output at line 1='
     )
52 X4b_stageII_output=X6d'+X4b;//Computing Stage-II
     output at line 2
53 disp(X4b_stageII_output,'Stage-II output at line 2='
     )
54 X2c_stageII_output=(X2c-X0a)*(-1);//Computing Stage-
     II output at line 3
55 disp(X2c_stageII_output,'Stage-II output at line 3='
     )
56 X6d_stageII_output=(X6d'-X4b)*(-1);//Computing Stage
     -II output at line 4
57 disp(X6d_stageII_output,'Stage-II output at line 4='
     )
58 X1e_stageII_output=X3g+X1e;//Computing Stage-II
     output at line 5
59 disp(X1e_stageII_output,'Stage-II output at line 5='
     )
60 X5f_stageII_output=X7h'+X5f;//Computing Stage-II
     output at line 6
```

```
61 disp(X5f_stageII_output,'Stage-II output at line 6=')
62 X3g_stageII_output=(X3g-X1e)*(-1);//Computing Stage-II output at line 7
63 disp(X3g_stageII_output,'Stage-II output at line 7=')
64 X7h_stageII_output=(X7h'-X5f)*(-1);//Computing Stage-II output at line 8
65 disp(X7h_stageII_output,'Stage-II output at line 8=')
66
67 //Stage-II output at line 6,line 7 and line 8 are to be multiplied by twiddle factor having value (0.707-j0.707),(-j) and (-0.707-j0.707) respectively
68 X5f_stageII_output_multiplied_by_twiddle=(X5f_stageII_output)*(0.707-(sqrt(-1))*(0.707));
69 disp(X5f_stageII_output_multiplied_by_twiddle,'Stage-II output at line 6 after multiplication by twiddle factor=')
70 X3g_stageII_output_multiplied_by_twiddle=(X3g_stageII_output)*(-(sqrt(-1)));
71 disp(X3g_stageII_output_multiplied_by_twiddle,'Stage-II output at line 7 after multiplication by twiddle factor=')
72 X7h_stageII_output_multiplied_by_twiddle=(X7h_stageII_output)*(-0.707-(sqrt(-1))*(0.707));
73 disp(X7h_stageII_output_multiplied_by_twiddle,'Stage-II output at line 8 after multiplication by twiddle factor=')
74
75 //Stage-III Computations(i.e. Computations for the final stage)
76 x0_star=(1/8)*(X1e_stageII_output+X0a_stageII_output);//Computing x*(0) at last stage
77 x1_star=(1/8)*(X5f_stageII_output_multiplied_by_twiddle+X4b_stageII_output);//Computing x*(1) at last
```

```
    stage
78  x2_star=(1/8)*(
    X3g_stageII_output_multiplied_by_twiddle+
    X2c_stageII_output);//Computing x*(2) at last
    stage
79  x3_star=(1/8)*(
    X7h_stageII_output_multiplied_by_twiddle+
    X6d_stageII_output);//Computing x*(3) at last
    stage
80  x4_star=(1/8)*((X1e_stageII_output-
    X0a_stageII_output)*(-1));//Computing x*(4) at
    last stage
81  x5_star=(1/8)*((
    X5f_stageII_output_multiplied_by_twiddle-
    X4b_stageII_output)*(-1));//Computing x*(5) at
    last stage
82  x6_star=(1/8)*((
    X3g_stageII_output_multiplied_by_twiddle-
    X2c_stageII_output)*(-1));//Computing x*(6) at
    last stage
83  x7_star=(1/8)*((
    X7h_stageII_output_multiplied_by_twiddle-
    X6d_stageII_output)*(-1));//Computing x*(7) at
    last stage
84  disp(x0_star,'x*(0)=')
85  disp(x1_star,'x*(1)=')
86  disp(x2_star,'x*(2)=')
87  disp(x3_star,'x*(3)=')
88  disp(x4_star,'x*(4)=')
89  disp(x5_star,'x*(5)=')
90  disp(x6_star,'x*(6)=')
91  disp(x7_star,'x*(7)=')
92  disp({,x0_star,x1_star,x2_star,x3_star,x4_star,
    x5_star,x6_star,x7_star,},'x*(n)=')
93  x0_star_real=real(x0_star);
94  x0_star_imag_conj=(-1)*(imag(x0_star));
95  x1_star_real=real(x1_star);
96  x1_star_imag_conj=(-1)*(imag(x1_star));
```

```
x2_star_real=real(x2_star);
x2_star_imag_conj=(-1)*(imag(x2_star));
x3_star_real=real(x3_star);
x3_star_imag_conj=(-1)*(imag(x3_star));
x4_star_real=real(x4_star);
x4_star_imag_conj=(-1)*(imag(x4_star));
x5_star_real=real(x5_star);
x5_star_imag_conj=(-1)*(imag(x5_star));
x6_star_real=real(x6_star);
x6_star_imag_conj=(-1)*(imag(x6_star));
x7_star_real=real(x7_star);
x7_star_imag_conj=(-1)*(imag(x7_star));
x0=x0_star_real+x0_star_imag_conj;
x1=x1_star_real+x1_star_imag_conj;
x2=x2_star_real+x2_star_imag_conj;
x3=x3_star_real+x3_star_imag_conj;
x4=x4_star_real+x4_star_imag_conj;
x5=x5_star_real+x5_star_imag_conj;
x6=x6_star_real+x6_star_imag_conj;
x7=x7_star_real+x7_star_imag_conj;
disp({,x0,x1,x2,x3,x4,x5,x6,x7,},'So,the IDFT of X(k
   ) using Inverse Decimation-in-Time Fast Fourier
   Transform(IDIT-FFT) is x(n)=')
```

Experiment: 6

N=8; DIF-FFT Without Using Inbuilt Scilab FFT Function

Scilab code Solution 6.0 Experiment Number 6

```
1  //AIM :N=8; DIF–FFT without using inbuilt Scilab FFT
       function
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6  //Let x(n)={1,2,1,2,0,2,1,2}
7  //Let us begin with the programming.For
       understanding,let us write the given data as
8  //x(0)=1;x(1)=2,x(2)=1,x(3)=2,x(4)=0,x(5)=2,x(6)=1,x
       (7)=2
9  x0=1;//DIF–FFT,so arranging the input in natural
       order
10 x1=2;//DIF–FFT,so arranging the input in natural
       order
11 x2=1;//DIF–FFT,so arranging the input in natural
       order
12 x3=2;//DIF–FFT,so arranging the input in natural
       order
```

```
13 x4=0;//DIF-FFT,so arranging the input in natural
      order
14 x5=2;//DIF-FFT,so arranging the input in natural
      order
15 x6=1;//DIF-FFT,so arranging the input in natural
      order
16 x7=2;//DIF-FFT,so arranging the input in natural
      order
17 //Stage I computation
18 x0a=x4+x0;//Computing Stage-I output at line 1
19 disp(x0a,'Stage-I output at line 1=')
20 x1b=x5+x1;//Computing Stage-I output at line 2
21 disp(x1b,'Stage-I output at line 2=')
22 x2c=x6+x2;//Computing Stage-I output at line 3
23 disp(x2c,'Stage-I output at line 3=')
24 x3d=x7+x3;//Computing Stage-I output at line 4
25 disp(x3d,'Stage-I output at line 4=')
26 x4e=(x4-x0)*(-1);//Computing Stage-I output at line
      5
27 disp(x4e,'Stage-I output at line 5=')
28 x5f=(x5-x1)*(-1);//Computing Stage-I output at line
      6
29 disp(x5f,'Stage-I output at line 6=')
30 x6g=(x6-x2)*(-1);//Computing Stage-I output at line
      7
31 disp(x6g,'Stage-I output at line 7')
32 x7h=(x7-x3)*(-1);//Computing Stage-I output at line
      8
33 disp(x7h,'Stage-I output at line 8=')
34
35 //Stage-I output at line 6,line 7 and line 8 are to
      be multiplied by twiddle factor having value
      (0.707-j0.707),(-j) and (-0.707-j0.707)
      respectively
36 x5f_stageI_output_multiplied_by_twiddle=(x5f)
      *(0.707-(sqrt(-1))*(0.707));
37 disp(x5f_stageI_output_multiplied_by_twiddle,'Stage-
      I output at line 6 after multiplication by
```

```
    twiddle factor=')
38 x6g_stageI_output_multiplied_by_twiddle=(x6g)*(-(
    sqrt(-1)));
39 disp(x6g_stageI_output_multiplied_by_twiddle,'Stage-
    I output at line 7 after multiplication by
    twiddle factor=')
40 x7h_stageI_output_multiplied_by_twiddle=(x7h)
    *(-0.707-(sqrt(-1))*(0.707));
41 disp(x7h_stageI_output_multiplied_by_twiddle,'Stage-
    I output at line 8 after multiplication by
    twiddle factor=')
42
43 //Stage-II Computations
44 x0a_stageII_output=x2c+x0a;//Computing Stage-II
    output at line 1
45 disp(x0a_stageII_output,'Stage-II output at line 1='
    )
46 x1b_stageII_output=x3d+x1b;//Computing Stage-II
    output at line 2
47 disp(x1b_stageII_output,'Stage-II output at line 2='
    )
48 x2c_stageII_output=(x2c-x0a)*(-1);//Computing Stage-
    II output at line 3
49 disp(x2c_stageII_output,'Stage-II output at line 3='
    )
50 x3d_stageII_output=(x3d-x1b)*(-1);//Computing Stage-
    II output at line 4
51 disp(x3d_stageII_output,'Stage-II output at line 4='
    )
52 x4e_stageII_output=x6g+x4e;//Computing Stage-II
    output at line 5
53 disp(x4e_stageII_output,'Stage-II output at line 5='
    )
54 x5f_stageII_output=
    x7h_stageI_output_multiplied_by_twiddle+
    x5f_stageI_output_multiplied_by_twiddle;//
    Computing Stage-II output at line 6
55 disp(x5f_stageII_output,'Stage-II output at line 6='
```

```
    )
x6g_stageII_output=(
    x6g_stageI_output_multiplied_by_twiddle-x4e)*(-1)
    ;//Computing Stage-II output at line 7
disp(x6g_stageII_output,'Stage-II output at line 7='
    )
x7h_stageII_output=(x7h'-x5f)*(-1);//Computing Stage
    -II output at line 8
disp(x7h_stageII_output,'Stage-II output at line 8='
    )

//Stage-II output at line 4 and line 8 are to be
    multiplied by twiddle factor having value (-j)
x3d_stageII_output_multiplied_by_twiddle=(
    x3d_stageII_output)*(-(sqrt(-1)));
disp(x3d_stageII_output_multiplied_by_twiddle,'Stage
    -II output at line 4 after multiplication by
    twiddle factor=')
x7h_stageII_output_multiplied_by_twiddle=(
    x7h_stageII_output)*(-(sqrt(-1)));
disp(x7h_stageII_output_multiplied_by_twiddle,'Stage
    -II output at line 8 after multiplication by
    twiddle factor=')

//Stage-III Computations(i.e. Computations for the
    final stage)
X0=x1b_stageII_output+x0a_stageII_output;//Computing
    X(0) at last stage
X4=(x1b_stageII_output-x0a_stageII_output)*(-1);//
    Computing X(4) at last stage
X2=x3d_stageII_output_multiplied_by_twiddle+
    x2c_stageII_output;//Computing X(2) at last stage
X6=(x3d_stageII_output_multiplied_by_twiddle-
    x2c_stageII_output)*(-1);//Computing X(6) at last
    stage
X1=(x5f_stageII_output+x4e_stageII_output);//
    Computing X(1) at last stage
X5=(x5f_stageII_output-x4e_stageII_output)*(-1);//
```

```
    Computing X(5) at last stage
X3=x7h_stageII_output_multiplied_by_twiddle+
    x6g_stageII_output;//Computing X(3) at last stage
X7=(x7h_stageII_output_multiplid_by_twiddle-
    x6g_stageII_output)*(-1);//Computing X(7) at last
     stage
disp(X0,'X(0)=')
disp(X4,'X(4)=')
disp(X2,'X(2)=')
disp(X6,'X(6)=')
disp(X1,'X(1)=')
disp(X5,'X(5)=')
disp(X3,'X(3)=')
disp(X7,'X(7)=')
disp({,X0,X1,X2,X3,X4,X5,X6,X7,},'So,the DFT of x(n)
     using Decimation-in-Frequency Fast Fourier
    Transform(DIF-FFT) is X(k)=')
```

Experiment: 7

N=8;IDIF-FFT Without Using Inbuilt Scilab FFT Function

Scilab code Solution 7.0 Experiment Number 7

```
1 //AIM:N=8;IDIF-FFT without using inbuilt Scilab FFT
    function
2 //Software version Scilab 5.5.2
3 //OS windows 10
4 clc;
5 clear;
6 //Let X(k)={11,1,-1,1,-5,1,-1,1}
7 //Let us begin with the programming.For
    understanding,let us write the given data as
8 //X(0)=11;X(1)=1,X(2)=-1,X(3)=1,X(4)=-5,X(5)=1,X(6)
    =-1,X(7)=1
9 X0_conj=11;//IDIF-FFT,so arranging the input in
    natural order
10 X1_conj=1;//IDIF-FFT,so arranging the input in
    natural order
11 X2_conj=-1;//IDIF-FFT,so arranging the input in
    natural order
12 X3_conj=1;//IDIF-FFT,so arranging the input in
    natural order
```

```
13 X4_conj=-5;//IDIF-FFT,so arranging the input in
      natural order
14 X5_conj=1;//IDIF-FFT,so arranging the input in
      natural order
15 X6_conj=-1;//IDIF-FFT,so arranging the input in
      natural order
16 X7_conj=1;//IDIF-FFT,so arranging the input in
      natural order
17 disp(X0_conj,'X*(0)=')
18 disp(X1_conj,'X*(1)=')
19 disp(X2_conj,'X*(2)=')
20 disp(X3_conj,'X*(3)=')
21 disp(X4_conj,'X*(4)=')
22 disp(X5_conj,'X*(5)=')
23 disp(X6_conj,'X*(6)=')
24 disp(X7_conj,'X*(7)=')
25
26 // Twiddle factor
27 W0=cos(((2*%pi)/8)*0)-(sqrt(-1))*sin(((2*%pi)/8)*0)
28 W1=cos(((2*%pi)/8)*1)-sqrt(-1)*sin(((2*%pi)/8)*1)
29 W2=cos(((2*%pi)/8)*2)-sqrt(-1)*sin(((2*%pi)/8)*2)
30 W3=cos(((2*%pi)/8)*3)-sqrt(-1)*sin(((2*%pi)/8)*3)
31
32 //Stage I computation
33 x0a=X0_conj+X4_conj
34 x1b=X1_conj+X5_conj
35 x2c=X2_conj+X6_conj
36 x3d=X3_conj+X7_conj
37 x4e=X0_conj+(-1)*X4_conj
38 x5f=X1_conj+(-1)*X5_conj
39 x6g=X2_conj+(-1)*X6_conj
40 x7h=X3_conj+(-1)*X7_conj
41 disp('Stage-I values are')
42 disp(x0a)
43 disp(x1b)
44 disp(x2c)
45 disp(x3d)
46 disp(x4e)
```

```
47 disp(x5f)
48 disp(x6g)
49 disp(x7h)
50 //Stage I output at line 4,5,6 & 7 are to be
      multiplied by factors W0, W1, W2, and W3
      respectively
51 x4e1=x4e*W0
52 x5f1=x5f*W1
53 x6g1=x6g*W2
54 x7h1=x7h*W3
55
56 //Stage II computation
57 x0a_stageII_output=x2c+x0a;//Computing Stage-II
      output at line 1
58 disp(x0a_stageII_output,'Stage-II output at line 1='
      )
59 x1b_stageII_output=x3d+x1b;//Computing Stage-I
      output at line 2
60 disp(x1b_stageII_output,'Stage-II output at line 2='
      )
61 x2c_stageII_output=x0a-x2c;//Computing Stage-I
      output at line 3
62 disp(x2c_stageII_output,'Stage-II output at line 3='
      )
63 x3d_stageII_output=x1b-x3d;//Computing Stage-I
      output at line 4
64 disp(x3d_stageII_output,'Stage-II output at line 4='
      )
65 x4e_stageII_output=x6g+x4e1;//Computing Stage-II
      output at line 5
66 disp(x4e_stageII_output,'Stage-II output at line 5='
      )
67 x5f_stageII_output=x7h+x5f1//Computing Stage-II
      output at line 6
68 disp(x5f_stageII_output,'Stage-II output at line 6='
      )
69 x6g_stageII_output=x4e1+(x6g1*(-1));//Computing
      Stage-II output at line 7
```

```
70 disp(x6g_stageII_output,'Stage-II output at line 7=')
71 x7h_stageII_output=x5f1+(x7h1*(-1));//Computing Stage-II output at line 8
72 disp(x7h_stageII_output,'Stage-II output at line 8=')
73
74 //Stage III computation
75 x0=x0a_stageII_output+x1b_stageII_output;//
76 x4=x0a_stageII_output+(-1)*x1b_stageII_output
77 x2=x3d_stageII_output*((-1)*sqrt(-1))+x2c_stageII_output;//at line 2 x3d_stageII_output is to be multiplied by factor -j
78 x6=x3d_stageII_output*((-1)*sqrt(-1))*(-1)+x2c_stageII_output;//at line 3 x3d_stageII_output is to be multioplied by factor -j*(-1)
79 x1=x4e_stageII_output+x5f_stageII_output
80 x5=x4e_stageII_output-x5f_stageII_output
81 x3=x7h_stageII_output*((-1)*sqrt(-1))+x6g_stageII_output;//at line 7 x7h_stageII_output is to b e multiplied by factor -j
82 x7=x7h_stageII_output*((-1)*sqrt(-1))*(-1)+x6g_stageII_output;// at line 8 x7h_stageII_output is to be multiplied by factor (-j)*(-1)
83 //final computation
84 x0_star=(1/8)*(x0)
85 disp(x0_star,'x*(0)=')
86 x4_star=(1/8)*(x4)
87 disp(x4_star,'x*(4)=')
88 x2_star=(1/8)*(x2)
89 disp(x2_star,'x*(2)=')
90 x6_star=(1/8)*(x6)
91 disp(x6_star,'x*(6)=')
92 x1_star=(1/8)*(x1)
93 disp(x1_star,'x*(1)=')
94 x5_star=(1/8)*(x5)
95 disp(x5_star,'x*(5)=')
```

```
x3_star=(1/8)*(x3)
disp(x3_star,'x*(3)=')
x7_star=(1/8)*(x7)
disp(x7_star,'x*(7)=')

disp({,x0_star,x1_star,x2_star,x3_star,x4_star,
   x5_star,x6_star,x7_star,},'x*(n)=')
x0_star_real=real(x0_star);
x0_star_imag_conj=(-1)*(imag(x0_star));
x1_star_real=real(x1_star);
x1_star_imag_conj=(-1)*(imag(x1_star));
x2_star_real=real(x2_star);
x2_star_imag_conj=(-1)*(imag(x2_star));
x3_star_real=real(x3_star);
x3_star_imag_conj=(-1)*(imag(x3_star));
x4_star_real=real(x4_star);
x4_star_imag_conj=(-1)*(imag(x4_star));
x5_star_real=real(x5_star);
x5_star_imag_conj=(-1)*(imag(x5_star));
x6_star_real=real(x6_star);
x6_star_imag_conj=(-1)*(imag(x6_star));
x7_star_real=real(x7_star);
x7_star_imag_conj=(-1)*(imag(x7_star));
x0=x0_star_real+x0_star_imag_conj;
x1=x1_star_real+x1_star_imag_conj;
x2=x2_star_real+x2_star_imag_conj;
x3=x3_star_real+x3_star_imag_conj;
x4=x4_star_real+x4_star_imag_conj;
x5=x5_star_real+x5_star_imag_conj;
x6=x6_star_real+x6_star_imag_conj;
x7=x7_star_real+x7_star_imag_conj;
disp({,x0,x1,x2,x3,x4,x5,x6,x7,},'So,the IDFT of X(k
   ) using Inverse Decimation-in-Frequency Fast
   Fourier Transform(IDIF-FFT) is x(n)=')
```

Experiment: 8

Compute Kaiser Window Parameter Beta & Its Minimum Length

Scilab code Solution 8.0 Experiment Number 8

```
1 //AIM:Compute Kaiser window parameter Beta & its
     minimum length
2 //Software version Scilab 5.5.2
3 //OS windows 10
4 clc;
5 clear;
6 //Let us consider the following specifications :
7 // H ( ) 0 .01 0 0 .25
8 //0.95 H ( ) 1 .05 0.35
            0 .6
9 // H ( ) 0 .01 0.65
10 //The magnitude specifications of the FIR filter is
     given by
11 // 1- pH ( ) 1+ p for 0 p
12 // 0 H ( ) s for s
13 //On comparing,we get 1- p =0.95
14 del_p=0.05;
```

```
del_s=0.01;
omega_p=0.6*(%pi);
omega_s=0.65*(%pi);
del_omega=omega_s-omega_p;
//   ia minimum of  p  and minimum of  s
del=0.05;
//Attenuation A is given as
A=((-20)*(log10(del)));
disp("dB",A,"Attenuation(A)=")
//Calculating value of
beeta=(A-21)^(0.4)+0.07886+(A-21);
disp(beeta,"  =")
//The length of filter is (M+1)
//The value of M is calculated as follows
M=((A-8)/(2.285*(del_omega)));
disp(M,"M=")
```

Experiment: 9

Design High Pass Butterworth Filter Using Bilinear Transformation

Scilab code Solution 9.0 Experiment Number 9

```
1  //AIM:Design High pass Butterworth filter using
       Bilinear Transformation.
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6  s=poly(0,"s")
7  T=1;//Assume T=1 second
8  Ap=0.8;//Attenuation in pass band
9  As=0.2;//Attenuation in stop band
10 wp=0.2*(%pi)
11 ws=0.6*(%pi)
12 ohmp=2/T*(tan(wp/2))
13 ohms=2/T*(tan(ws/2))
14 //ORDER CALCULATION(N);
15 a=(1/As^2-1)
16 b=(1/Ap^2-1)
```

```
c=log(a/b)
N=(1/2)*(c/(log(ohms/ohmp)))
Nr=int (N)
x=N-int(N)
if(x>0)
 Nr=Nr+1
ohmc=(ohmp/(1/Ap^2-1)^(1/(2*Nr)))
//calculation of poles
i=0:1:Nr-1;
pi_plus=ohmc*exp(%i*(Nr+2*i+1)*(%pi)/(2*Nr))
pi_minus=-ohmc*exp(%i*(2+2.*i+1)*(%pi)/(2*Nr))
disp(wp,' p =')
disp(ws,' s =')
disp(ohmp,' p =')
disp(ohms,' s =')
disp(N','Order (N)=')
disp(Nr,'Integer value of the order:(Nr)=')
disp(ohmc,' c =')
disp(pi_plus,'Poles=')
disp(pi_minus,'Poles=')
h=ohmc/(s-(-0.53-0.53*%i))
h1=ohmc/(s-(-0.53+0.53*%i))
h2=h*h1;
disp(h,h1,'The analog transfer function will be the
   multiplication of the following two terms:');
disp(h2,'The analog transfer function H(s)=')
Z=poly(0,"Z")
s=(ohmc*ohmp)/((2/T)*((Z-1)/(Z+1)));
h3=0.56/(s^2+1.06*s+0.56);
disp(h3,"Transfer function of digital filter H(Z)=")
```

Experiment: 10

Overlap Add Method To Filter Long Sequences Using Linear Convolution

Scilab code Solution 10.0 Experiment Number 10

```
1  //AIM: Overlap add method to filter long sequences
       using linear convolution
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6  //Let x(n)={1,2,3,4,5,6,7,8} and h(n)={1,2}
7  xn =[1 2 3 4 5 6 7 8]; //Nx=8
8  xon =[1 2];
9  xono=1;
10 xon1=2;
11 x1n =[3 4];
12 x1no=3;
13 x1n1=4;
14 x2n =[5 6];
15 x2no=5;
16 x2n1=6;
```

```
17 x3n =[7 8];
18 x3no=7;
19 x3n1=8;
20 hn =[1 2]; //Here length of impulse response array h
      (n) is 2 (i.e. M=2) or Nh=2
21 //Length of each partitioned input i.e x0n to x3n is
      2(i.e. L=2)
22 //Since Nx=8,Nh=2 and we know Nx=m*Nh(so 8=m*2)
      giving m=4;and so x(n) has been partitioned into
      4 blocks of length Nh=2
23 hno=1;
24 hn1=2;
25
26 a=xono*hno;
27 b=xon1*hno;
28 c=xono*hn1;
29 d=xon1*hn1;
30 yon=[a c+b d];
31 disp(yon,'yon=')
32
33 e=x1no*hno;
34 f=x1n1*hno;
35 g=x1no*hn1;
36 h=x1n1*hn1;
37 y1n=[e g+f h];
38 disp(y1n,'y1n=')
39
40 i=x2no*hno;
41 j=x2n1*hno;
42 k=x2no*hn1;
43 l=x2n1*hn1;
44 y2n=[i k+j l];
45 disp(y2n,'y2n=')
46
47 m=x3no*hno;
48 n=x3n1*hno;
49 o=x3no*hn1;
50 p=x3n1*hn1;
```

```
51 y3n=[m o+n p];
52 disp(y3n,'y3n=')
53
54 yon =[yon,0,0,0,0,0,0]
55 y1n =[0,0,y1n,0,0,0,0]
56 y2n =[0,0,0,0,y2n,0,0]
57 y3n =[0,0,0,0,0,0,y3n ]
58
59 yn=yon+ y1n+y2n+y3n
60 disp(yn,'So,the output using overlap add method(
      without using inbuilt functions) is y(n)= ')
```

Experiment: 11

Overlap Save Method For Sectioned Convolution Using Matrix Approach

Scilab code Solution 11.0 Experiment Number 11

```
1  //AIM: Overlap save method for sectioned convolution
       using matrix approach.
2  //Software version Scilab 5.5.2
3  //OS windows 10
4  clc;
5  clear;
6  xn =[1 2 -1 2 3 -2 -3 -1 1 1 2 -1]; //Nx=12
7  hn =[1 2 3];    //Nh=3
8  //L(approx.=)2*Nh,so L(approx.=)2*3
9  //So(approx=)6
10 //We consider the length as 5
11 //Nh-1=3-1=2
12 //So Nh-1 number of leading zeros to be added to x(n
       )
13 //So xn=[0 0 1 2 -1 2 3 -2 -3 -1 1 1 2 -1]
14 x0n =[0 0 1 2 -1]; //Partitioned input sequence
15 x1n =[2 -1 2 3 -2];//Partitioned input sequence
```

```
16 x2n =[3 -2 -3 -1 1];//Partitioned input sequence
17 x3n=[-1 1 1 2 -1];//Partitioned input sequence
18 x4n=[2 -1 0 0 0 ];//Partitioned input sequence
19 //Convolving each partitioned input sequence with hn
20 y0n =[0 -1 2 1 0; 0 0 -1 2 1; 1 0 0 -1 2; 2 1 0 0
      -1; -1 2 1 0 0]*[1;2;3;0;0];
21 disp(y0n,"y0n=")
22 y1n =[2 -2 3 2 -1; -1 2 -2 3 2; 2 -1 2 -2 3; 3 2 -1
      2 -2; -2 3 2 -1 2]*[1;2;3;0;0];
23 disp(y1n,"y1n=")
24 y2n =[3 1 -1 -3 -2; -2 3 1 -1 -3; -3 -2 3 1 -1;-1 -3
       -2 3 1; 1 -1 -3 -2 3]*[1;2;3;0;0];
25 disp(y2n,"y2n=")
26 y3n=[-1 -1 2 1 1;1 -1 -1 2 1; 1 1 -1 -1 2;2 1 1 -1
      -1; -1 2 1 1 -1]*[1;2;3;0;0];
27 disp(y3n,"y3n=")
28 y4n=[2 0 0 0 -1; -1 2 0 0 0; 0 -1 2 0 0; 0 0 -1 2 0;
       0 0 0 -1 2]*[1;2;3;0;0];
29 disp(y4n,"y4n=")
30 yn0 = y0n (3:5)
31 //(3:5) means that from yon,select the element from
      3rd to 5th
32 yn1 = y1n (3:5)
33 yn2 = y2n (3:5)
34 yn3 = y3n (3:5)
35 yn4 = y4n (3:5)
36 yn =[yn0;yn1;yn2;yn3;yn4] //Concatenating yno,yn1,
      yn2,yn3 and yn4
37 disp(yn,"y(n)=")
```