

Scilab Textbook Companion for
Signals And Systems
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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

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Chapter 1

Introduction to Signal and Systems

Scilab code Exa 1.6 Shifting Scaling Time Reversal

```
1 //shifting and scaling
2 //Ex 1.6
3 clear all;
4 clc;
5 close;
6 t = 0:1/100:2;
7 for i = 1:length(t)
8     if t(i)<1 then
9         x(i) = (2)*t(i) ;
10        else
11            x(i)= 2;
12        end
13 end
14 for i = length(t)+1:2*length(t)
15 x(i) = 0;
16 end
17 t1=0:1/100:4.01;
18 figure
19 subplot(3,1,1),plot2d(t1,x)
```

```

20 a=gca();
21 t2=t1-1;
22 subplot(3,1,2),plot2d(t2,x)
23 xtitle('x(t+1)')
24 a.y_location='origin'
25 a=gca();
26 subplot(3,1,3),plot2d(t1/1.5,x)
27 xtitle('x(1.5t)')
28 figure
29 a=gca();
30 subplot(2,1,1),plot2d((t2/1.5),x)
31 xtitle('x(1.5t+1)')
32 a.y_location='origin'
33 a=gca();
34 t3=-3:1/100:1.01;
35 subplot(2,1,2),plot2d(t3,x($:-1:1))
36 xtitle('x(-t+1)')
37 a.y_location = 'origin';

```

Scilab code Exa 1.9 Check for Periodicity

```

1 //Ex 1.9
2 //Check For periodicity
3 clc;
4 //pi=22/7
5 k=1;
6 N=2*7*k/5;
7 z=2*N;
8 n=0::1:z //Defining discrete time

```

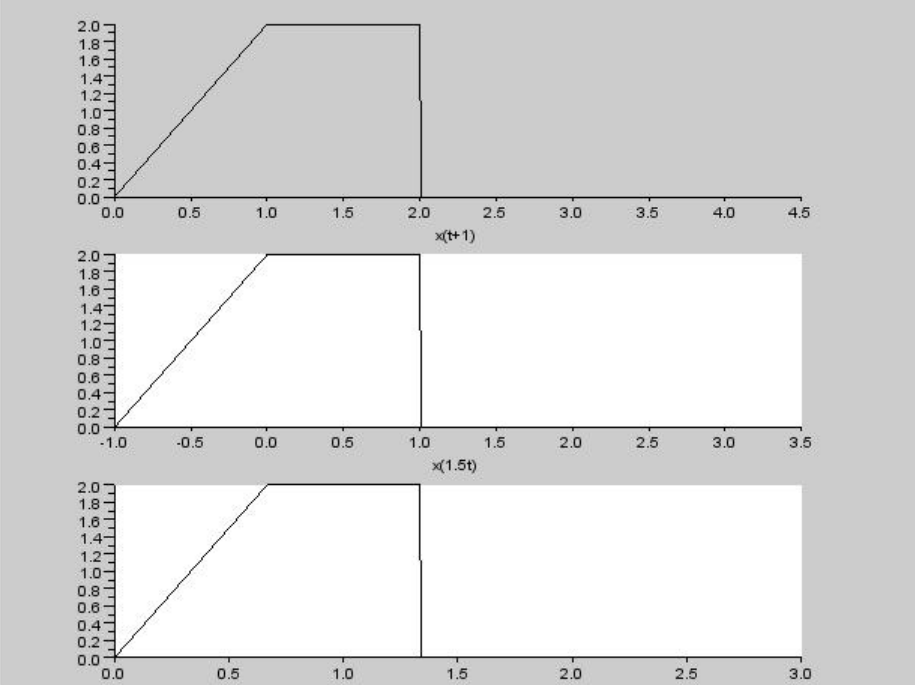


Figure 1.1: Shifting Scaling Time Reversal

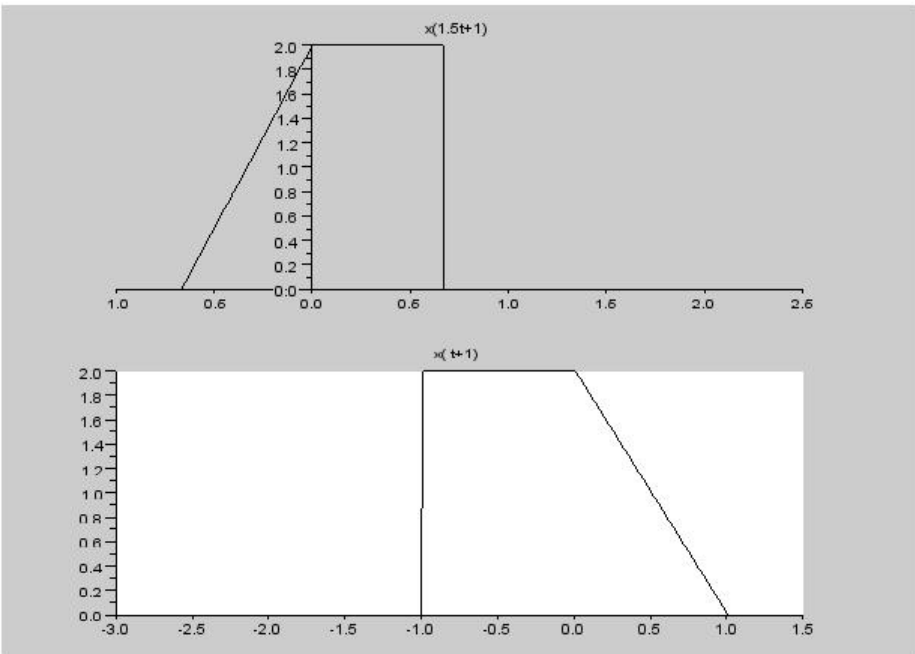


Figure 1.2: Shifting Scaling Time Reversal

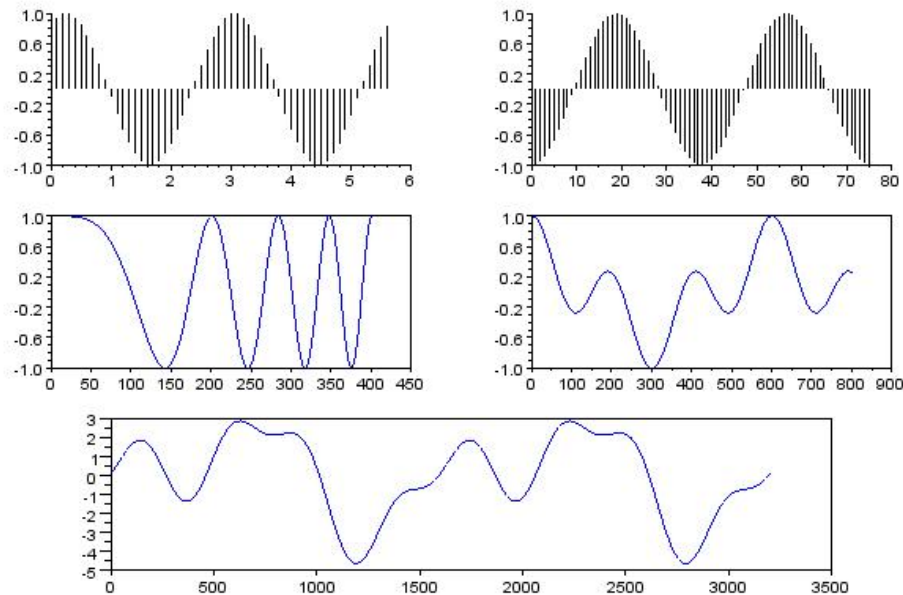


Figure 1.3: Check for Periodicity

```

9 x=sin((5*pi*n/7)+1); //sinusoid function
10 subplot(3,2,1),plot2d3(n,x) //plotting the sinusoid
    showing it as periodic 2piN=5piN/7
11 disp('the plot shows the above signal is periodic');
12
13 k=1;
14 N=2*pi*k*6;
15 z=2*N;
16 n=0:1:z //Defining discrete time
17 x=cos((n/6)-pi);
18 subplot(3,2,2),plot2d3(n,x); //the plot shows the
    above signal is periodic
19 disp('the plot shows the above signal is periodic');
20
21 k=1;
22 N=sqrt(2*k*2);
23 z=2*N;
24 n=0:1/100:z //Defining discrete time
25 x=cos(((n.^2)*pi)/2);

```

```

26 subplot(3,2,3),plot(x);//the plot shows that the
    above signal is not periodic
27 disp('the plot shows the above signal is not
    periodic');
28
29 k=1;
30 N=2*k;
31 z=2*N;
32 n=0:1/100:2*z //Defining discrete time
33 x=cos(n*pi/3).*cos(2*pi*n/3);
34 subplot(3,2,4),plot(x);//the plot shows that the
    above signal is periodic
35 disp('the plot shows the above signal is periodic');
36
37 k=1;
38 N=2*k*8;
39 z=2*N;
40 n=0:1/100:z //Defining discrete time
41 x=2*cos(n*pi/4)+sin((n*pi/2)-(pi/3))-2*cos((n*pi
    /8)+(pi/3));
42 subplot(3,1,3),plot(x);//the plot shows that the
    above signal is periodic
43 disp('the plot shows the above signal is periodic');

```

Scilab code Exa 1.11 Check for Periodicity

```

1 //Ex 1.11
2 //Check for peridicity
3 clc;
4 T=2*pi/8;
5 z=2*T;
6 t=0:0.001:z
7 x=%i*exp(%i*8*t);

```

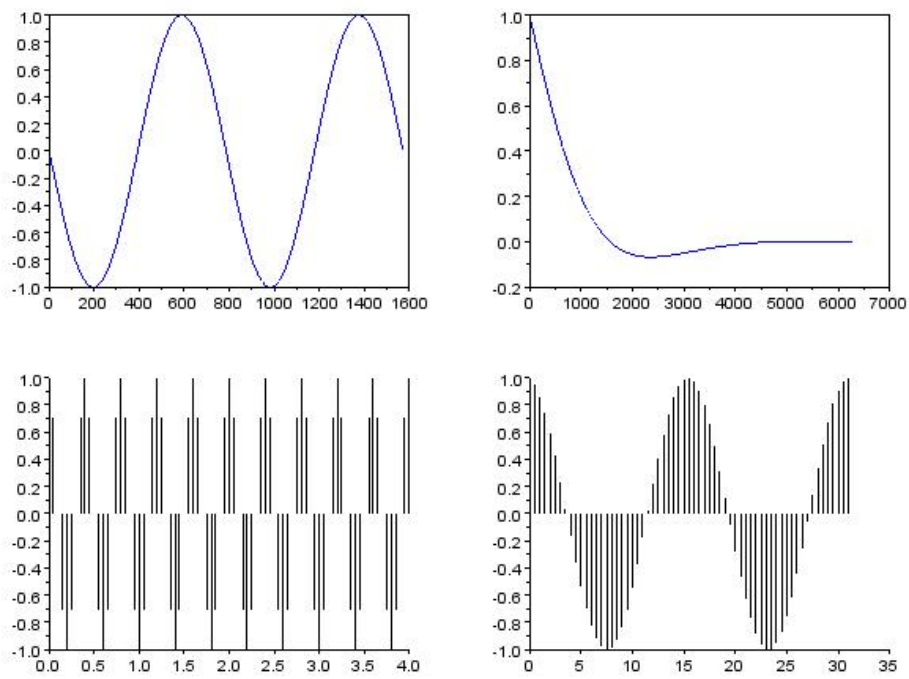


Figure 1.4: Check for Periodicity

```

8 subplot(2,2,1),plot(x);//the plot shows that the
   above signal is periodic
9
10 T=2*%pi/(-1+%i);
11 z=2*T;
12 disp('T cannot be complex so non periodic');
13 t=0:-0.001:z
14 x=exp((-1+%i)*abs(t));
15 subplot(2,2,2),plot(x);//the plot shows that the
   above signal is not periodic
16
17 N=2*%pi/%pi;
18 z=2*N;
19 n=0:0.05:z
20 x=exp(%i*5*%pi*n);//exp(i*(4*pi+pi)*n)=exp(i*pi*n)
21 subplot(2,2,3),plot2d3(n,x);//the plot shows that
   the above signal is periodic
22
23 k=1;
24 N=2*%pi*5/2;
25 z=2*N;
26 n=0:0.5:z
27 x=exp((%i*2/5)*(n+(1/3)));
28 subplot(2,2,4),plot2d3(n,x);//the plot shows that
   the above signal is periodic

```

Scilab code Exa 1.13 Check for Periodicity

```

1 //Ex 1.13
2 //Check for periodicity
3 clc;
4 T=2*%pi/6;
5 t=0:0.001:T*2

```

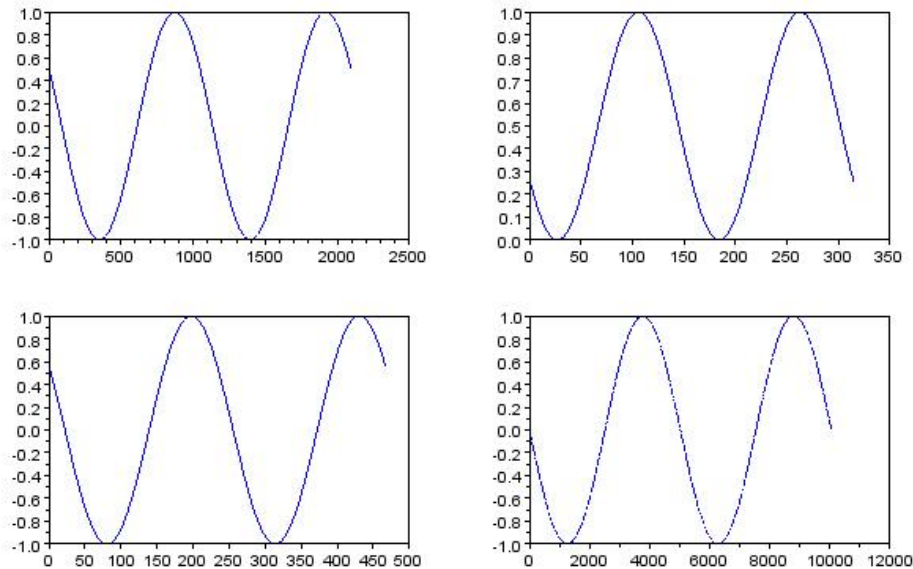



Figure 1.5: Check for Periodicity

```

6 x=cos((6*t)+%pi/3);
7 subplot(3,2,1),plot(x);
8 disp('the plot shows that the above signal is
    periodic ');
9
10 T=2*%pi/(%i*%pi);
11 t=0:0.001:T*2
12 x=exp(%i*(%pi*abs(t-1))); //exp(%i*(%pi*t-1))=exp(%i*
    %pi*t)/exp(%i)
13 //since the period is a complex no so non periodic
14 disp('T cannot be complex so non periodic T=2*%pi/(
    %i*%pi) ');
15
16 //pi=22/7
17 T=2*%pi/4; //calc the fundamental period
18 z=2*T;
19 t=0:1/100:z
20 x=(cos(2*t+%pi/3))^2; //sinusoid function
21 subplot(3,2,2),plot(x)

```

```

22 disp('the plot shows that the above signal is
    periodic ');
23
24 k=1;
25 N=2*k*7/6;
26 z=2*N;
27 n=0:1/100:z
28 x=cos((6*pi*n/7)+1);
29 subplot(3,2,3),plot(x);//the plot shows that the
    above signal is periodic
30 disp('the plot shows that the above signal is
    periodic ');
31
32 k=1;
33 N=2*pi*k*8;
34 z=2*N;
35 n=0:1/100:z
36 x=sin((n/8)-pi);
37 subplot(3,2,4),plot(x);//the plot shows that the
    above signal is periodic
38 disp('the plot shows that the above signal is
    periodic ');
39
40 k=1;
41 N=2*k*12; //2*cos(n*pi/4).*cos(n*pi/3)=cos(7*n*pi
    /12)-cos(n*pi/12)
42 z=2*N;
43 n=0:1/100:z
44 x=2*cos(n*pi/4).*cos(n*pi/3);
45 subplot(3,1,3),plot(x);//the plot shows that the
    above signal is periodic
46 disp('the plot shows the above signal is periodic ');

```

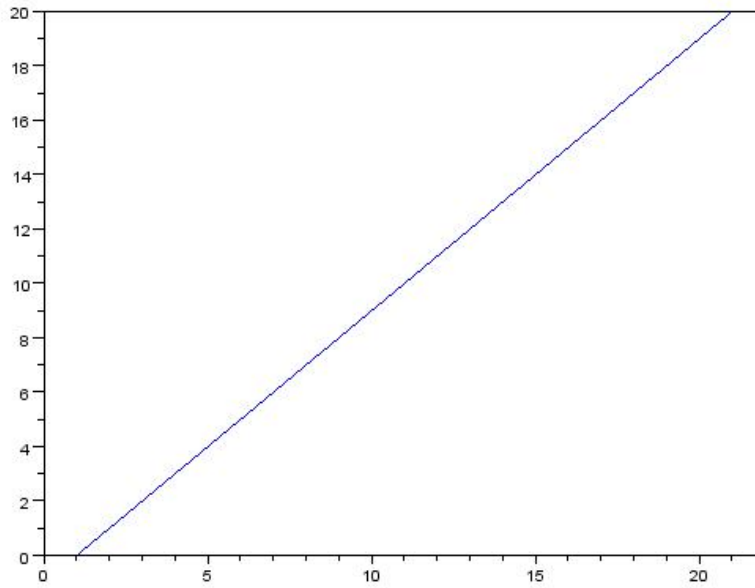


Figure 1.6: Integral of Unit step function

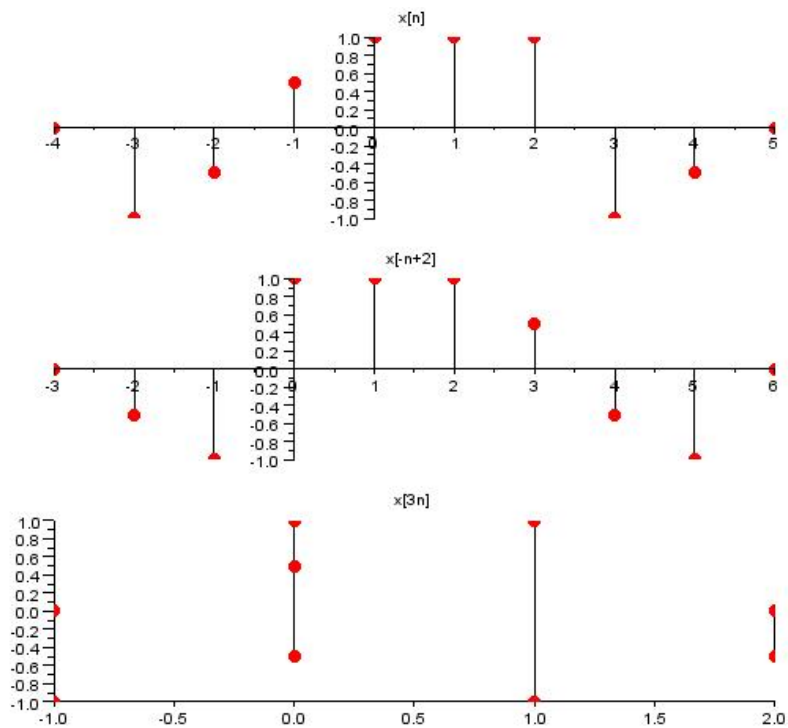


Figure 1.7: Shifting Time Reversal of discrete time signals

Scilab code Exa 1.30 Integral of Unit step function

```

1 //Ex 1.30
2 //Integral of unit step function
3 clc;
4 x0=0; //lower bound
5 x1=0:20; //upper bound vector
6 X=integrate('1', 'x', x0, x1);
7 //integration of unt step seq
8 //resulting in ramp seq
9 plot(X)

```

Scilab code Exa 1.37 Shifting Time Reversal of discrete time signals

```
1 //Ex 1.37
2 //shifting and scaling discrete signals
3 clear ;
4 clc;
5 close;
6 t=-4:5;
7 x=[0 -1 -.5 .5 1 1 1 -1 -.5 0]
8 a=gca();
9 subplot(3,1,1),plot2d3(t,x)
10 subplot(3,1,1),plot(t,x,'r. ')
11 xtitle('x[n] ')
12 a.x_location='origin';
13 a.y_location='origin';
14
15 t1=-5:4;
16 t2=t1+2;
17 a=gca();
18 subplot(3,1,2),plot2d3(t2,x($:-1:1))
19 subplot(3,1,2),plot(t2,x($:-1:1),'r. ')
20 xtitle('x[-n+2] ')
21
22 a=gca()
23 subplot(3,1,3),plot2d3(ceil(t/3),x)
24 subplot(3,1,3),plot(ceil(t/3),x,'r. ')
25 xtitle('x[3n] ')
26 a.x_location='origin';
27 a.y_location='origin';
```

Chapter 2

Analysis of LTI continuous time system

Scilab code Exa 2.2 Convolution

```
1 //Ex 2.2
2 clc;
3 h=ones(1,10);
4 N2=0:length(h)-1;
5 a=0.5;//constant a>0
6 for t=1:10
7     x(t)=exp(-a*(t-1));
8 end
9 N1=0:length(x)-1;
10 y=convol(x,h)-1;
11 N=0:length(x)+length(h)-2;
12
13 subplot(3,1,1),plot2d(N2,h)
14 xtitle('Impulse Response','t','h(t)');
15
16 subplot(3,1,2),plot2d(N1,x)
17 xtitle('Input Response','t','x(t)');
```

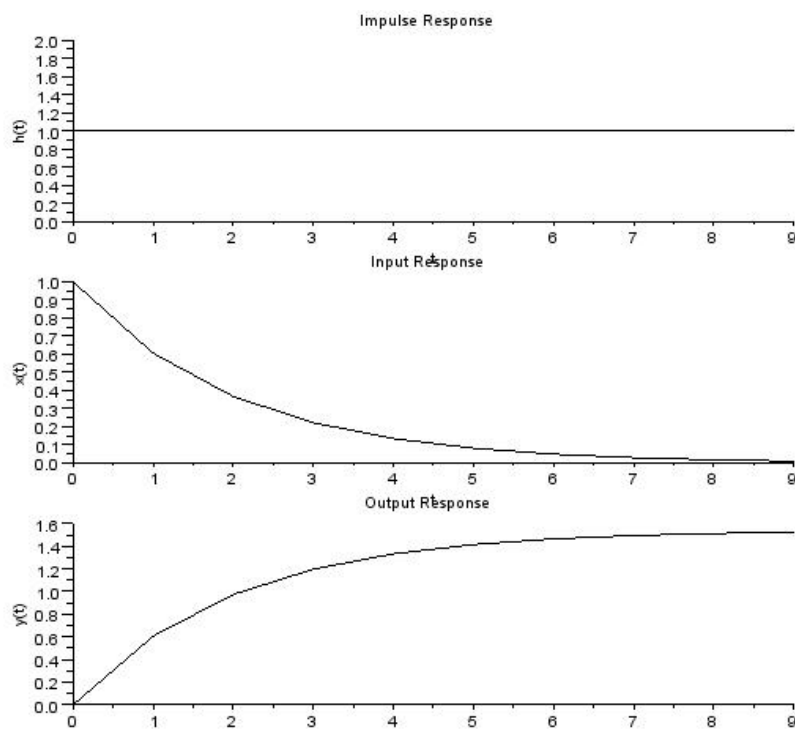


Figure 2.1: Convolution

```

18
19
20 subplot(3,1,3),plot2d(N(1:10),y(1:10))
21 xtitle('Output Response','t','y(t)');

```

Scilab code Exa 2.11.a Fourier transform of impulse function

```

1 //Fourier Transform of unit impulse
2 clc;
3 syms s t
4 X=symsum(1*%e^(-s*t),t,0,0);

```

Scilab code Exa 2.11.b Fourier transform of exponential function

```

1 clc;
2 A=1;
3 Dt=0.005;
4 t=-4.5:Dt:4.5;
5 xt=exp(-A*abs(t));
6 Wmax=2*%pi*1;
7 K=4;
8 k=0:(K/1000):K;
9 W=k*Wmax/K;
10 XW=xt*exp(-sqrt(-1)*t'*W)*Dt;
11 XW = real(XW);
12 W=[-mtlbfliplr(W),W(2:1001)];
13 XW=[mtlbfliplr(XW),XW(2:1001)];
14 subplot(1,1,1)
15 subplot(2,1,1);
16 a=gca();
17 a.y_location="origin";

```

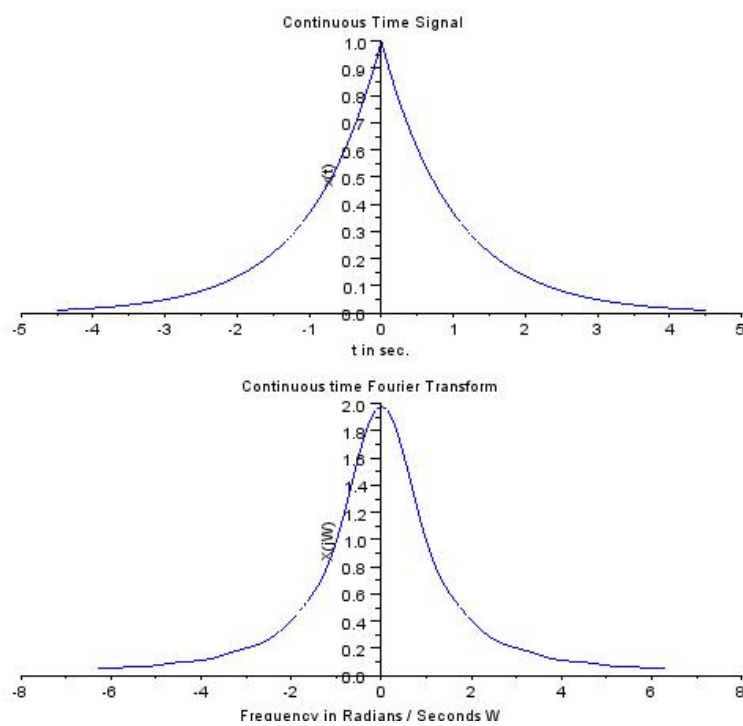



Figure 2.2: Fourier transform of exponential function

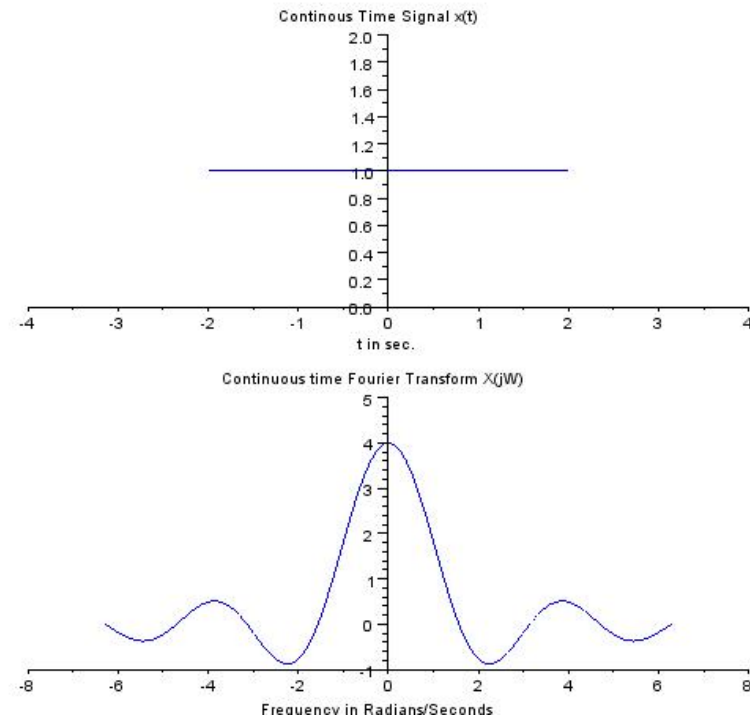


Figure 2.3: Fourier transform of Gate function

```

18 plot(t,xt);
19 xlabel( ' t in sec. ' );
20 ylabel( ' x(t) ' )
21 title( ' Continuous Time Signal ' )
22 subplot(2,1,2);
23 a=gca();
24 a.y_location="origin";
25 plot(W,XW);
26 xlabel( ' Frequency in Radians / Seconds W' );
27 ylabel( 'X(jW) ' )
28 title( ' Continuous time Fourier Transform ' )

```

Scilab code Exa 2.12 Fourier transform of Gate function

```
1 //Ex 2.12
2 clc;
3 clear;
4 A=1;
5 Dt=0.005;
6 T1=4;
7 t=-T1/2:Dt:T1/2;
8 for i=1:length(t)
9 xt(i)=A;
10 end
11 Wmax=2*%pi*1;
12 K=4;
13 k=0:(K/1000):K;
14 W=k*Wmax/K;
15 xt=xt';
16 XW=xt*exp(-sqrt(-1)*t'*W)*Dt;
17 XW_Mag=real(XW);
18 W=[-mtlbfliplr(W),W(2:1001)];
19 XW_Mag=[mtlbfliplr(XW_Mag),XW_Mag(2:1001)];
20 subplot(2,1,1);
21 a=gca();
22 a.data_bounds=[-4,0;4,2];
23 a.y_location="origin";
24 plot(t,xt);
25 xlabel('t in sec. ');
26 title('Continuous Time Signal x(t)');
27 subplot(2,1,2);
28 a=gca();
29 a.y_location="origin";
30 plot(W,XW_Mag);
31 xlabel('Frequency in Radians/Seconds');
32 title('Continuous time Fourier Transform X(jW)');
```

Scilab code Exa 2.14 Fourier transform one sided exponential function

```
1 //Ex 2.14
2 //Fourier Transform
3 clc ;
4 clear;
5 A=1;
6 Dt=0.005;
7 t=0:Dt:10;
8 xt=exp(-A*t);
9 Wmax=2*%pi*1;
10 K=4;
11 k=0:(K/1000):K;
12 W=k*Wmax/K;
13 XW=xt*exp(-sqrt(-1)*t'*W)*Dt;
14 XW_Mag=abs(XW);
15 W=[-mtlbfliplr(W),W(2:1001)];
16 XW_Mag=[mtlbfliplr(XW_Mag),XW_Mag(2:1001)];
17 [XW_Phase,db]=phasemag(XW);
18 XW_Phase=[-mtlbfliplr(XW_Phase),XW_Phase(2:1001)];
19 figure
20 a=gca();
21 a.y_location="origin";
22 plot(t,xt);
23 xlabel('t in sec. ');
24 ylabel('x(t) ');
25 title('Continuous Time Signal');
26 figure
27 subplot(2,1,1);
28 a=gca();
29 a.y_location="origin";
30 plot(W,XW_Mag);
31 xlabel('Frequency in Radians/Seconds>W');
32 ylabel('abs(X(jW)) ');
33 title('Magnitude Response (CTFT) ');
34 subplot(2,1,2);
35 a=gca();
36 a.y_location="origin";
```

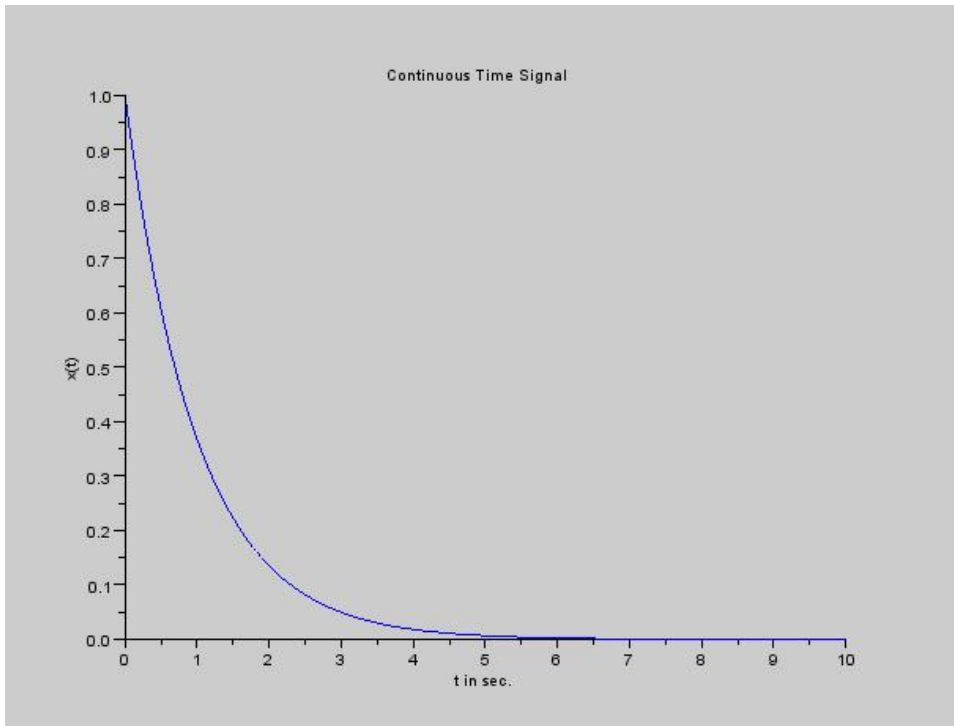


Figure 2.4: Fourier transform one sided exponential function

```

37 a.x_location="origin";
38 plot(W,XW_Phase*%pi/180) ;
39 xlabel(' Frequency in Radians/ S e c o n d s           > W
      ' );
40 ylabel('<X(jW)')
41 title('Phase Response (CTFT) in Radians');

```

Scilab code Exa 2.20.a Laplace transform of unit impulse

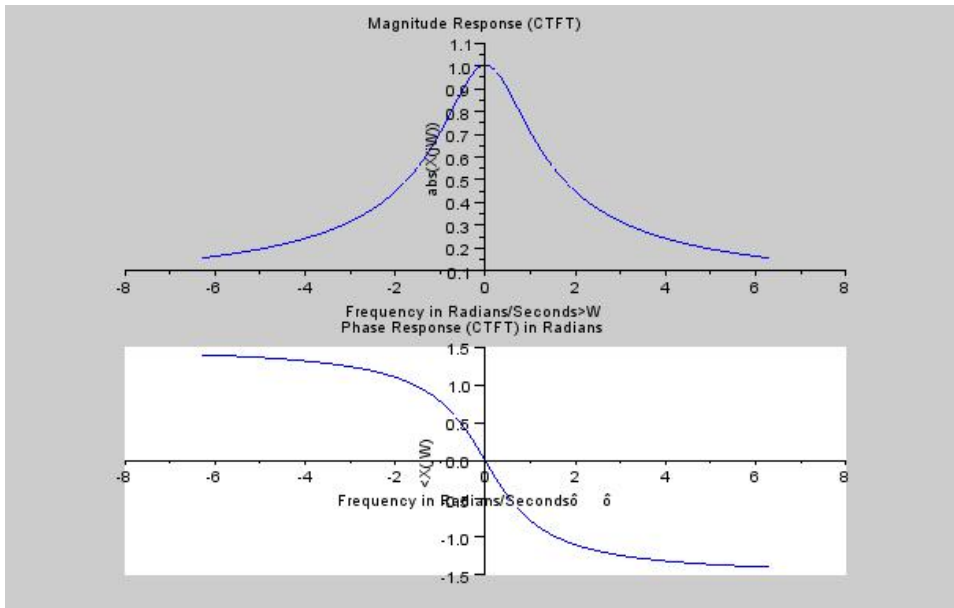


Figure 2.5: Fourier transform one sided exponential function

```

1 //laplace of unit impulse
2 clc;
3 syms s;
4 X=symsum(1*%e^(-s*t),t,0,0);

```

Scilab code Exa 2.23 Laplace Transform

```

1 syms a t;
2 x=exp(-a*t);
3 y=diff(x,t)
4 X=laplace(y);

```

Scilab code Exa 2.26.a Inv Laplace

```
1 syms s;  
2 x=ilaplace((s^2+2*s+1)/(s*(s+2)*(s+1)));  
3 disp (x);
```

Scilab code Exa 2.26.b Inv Laplace

```
1 syms s;  
2 x=ilaplace((2*s+3)/((s^2+4*s+5)*(s+1)));  
3 disp (x);
```

Scilab code Exa 2.26.c Inv Laplace

```
1 syms s;  
2 x=ilaplace(1/((s^2)*(s+1)));  
3 disp (x);
```

Scilab code Exa 2.28 Laplace Transform

```
1 clc;  
2 syms s ;  
3 X=5/((s+2)*(s-3));  
4 x=ilaplace(X);
```

Scilab code Exa 2.33 Plot the spectrum

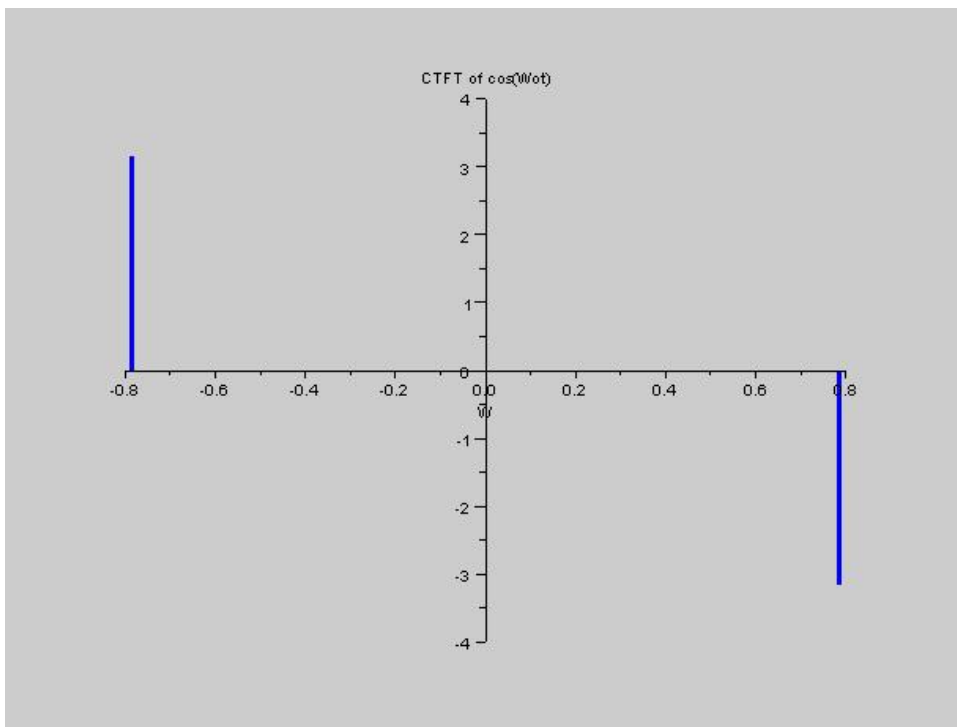


Figure 2.6: Plot the spectrum


```

1 //Ex 2.33
2 clc;
3 clear;
4 T1=2;
5 T=4*T1;
6 Wo=2*pi/T;
7 W=[-Wo,0,Wo];
8 ak=(2*pi*Wo*T1/pi)/sqrt(-1);
9 XW=[-ak,0,ak];
10 ak1=-(2*pi*Wo*T1/pi);
11 XW1=[-ak1,0,ak1];
12 figure
13 a=gca();
14 a.y_location="origin";
15 a.x_location="origin";
16 plot2d3('gnn',W,XW1,2);
17 poly1=a.children(1).children(1);
18 poly1.thickness=3;
19 xlabel('W');
20 title('CTFT of cos(Wot)');

```

Scilab code Exa 2.39 Convolution of two signals

```

1 //Ex 2.39
2 clc;
3 clear;
4 A=1;
5 Dt=0.005;
6 T1=1;
7 t=-T1:Dt:T1;
8 for i=1:length(t)
9 xt(i)=A;
10 end

```

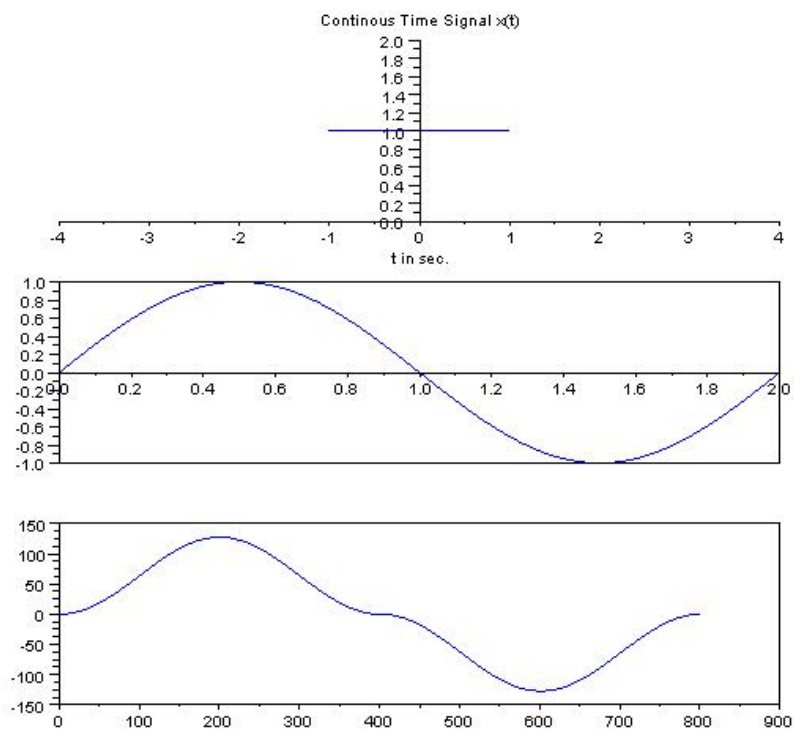


Figure 2.7: Convolution of two signals

```
11 xt=xt';
12 t1=0:0.005:2;
13 for j=1:length(t1)
14     x1(j)=sin(%pi*t1(j));
15 end
16 subplot(3,1,1);
17 a=gca();
18 a.data_bounds=[-4,0;4,2];
19 a.y_location="origin";
20 plot(t,xt);
21 xlabel('t in sec. ');
22 title('Continuous Time Signal x(t)');
23 subplot(3,1,2);
24 a=gca();
25 plot(t1,x1);
26 y=convol(x1,xt);
27 subplot(3,1,3);
28 a.y_location="origin";
29 a.x_location="origin";
30 plot(y);
```

Chapter 3

Analysis of LTI Discrete time system

Scilab code Exa 3.1 Convolution sum method

```
1  clc;
2  //k=2;
3  r=1;
4  k=0:1:2;
5  h=0.5^(k);
6  l1=convol(h,r);
7  disp(l1);
8  //k=3;
9  r=1;
10 k=0:1:3;
11 h=0.5^(k);
12 l2=convol(h,r);
13 disp(l2);
```

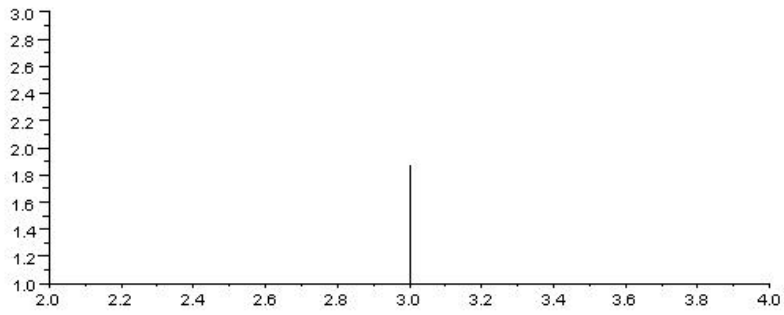
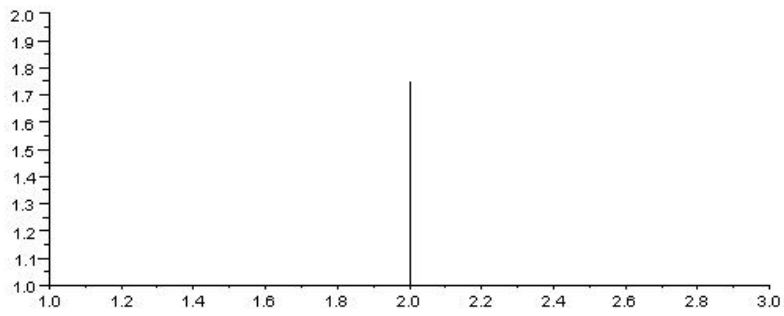


Figure 3.1: Graphical Convolution

Scilab code Exa 3.2 Graphical Convolution

```
1  clc ;
2  //k=2;
3  r=1;
4  k=0:1:2;
5  h=0.5^(k);
6  l1=convol(h,r);
7  s1=sum(l1);
8  disp(s1);
9  n=2;
10 subplot(2,1,1),plot2d3(n,s1);
11 //k=3;
12 r=1;
13 k=0:1:3;
14 h=0.5^(k);
15 l2=convol(h,r);
16 s2=sum(l2);
17 disp(s2);
18 m=3;
19 subplot(2,1,2),plot2d3(m,s2);
```

Scilab code Exa 3.17.b Z Transform

```
1  //Ex 3.17b
2  clc ;
3  syms z n;
4  x=1;
5  X=symsum(x*z^(-n),n,0,%inf);
6  disp(X);
```

Scilab code Exa 3.17.c Z Transform

```

1 //Ex 3.17c
2 clc;
3 syms z n B k;
4 x=exp(B*k);
5 X=symsum(x*z^(-n),n,0,%inf);
6 disp(X);

```

Scilab code Exa 3.17a Z Transform

```

1 //Ex 3.17a
2 clc;
3 syms z n;
4 x=1;
5 X=symsum(x*z^(-n),n,0,0);
6 disp(X);

```

Scilab code Exa 3.19 Final Value Theorem

```

1 //Ex 3.19
2 clc;
3 syms z;
4 c=(z-1)/(1+0.5*z^(-1))+(z^(-1)*(z-1))/((1+0.5*z^(-1)
    )*(1-z^(-1)));
5 l=limit(c,z,1);
6 disp(l);

```

Scilab code Exa 3.21 Inverse Ztransform

```

1 //Ex 3.21
2 clc;

```

```
3 z=%z;
4 x=ldiv(z^2,(z^3)-(1.7*(z^2))+0.8*z+0.1,3);
5 dims=1;
6 xo=[0];
7 y=cat(dims,xo,x);
8 //degree of Num polynomial And Den Polynomial must
   be same
9 // else Zeros are padded accordingly on the basis of
   Std Eq.
10 disp(y);
```

Scilab code Exa 3.22 Z inverse

```
1 //Ex 2.22 a
2 clc;
3 z=%z;
4 x=ldiv(z,z-0.4,4);
5 disp(x);
```

Chapter 4

Discrete Fourier Transform And Fast Fourier Transform

Scilab code Exa 4.4 DFT computation

```
1 clc ;  
2 a=0.5 ;  
3 for n=1:10  
4     x(n)=a^(n-1) ;  
5 end  
6 X=fft(x,-1) ;
```

Scilab code Exa 4.5 DFT computation

```
1 clc ;  
2 clear ;  
3 N1=8 ;  
4 n=-N1:N1 ;  
5 for i=1:length(n)  
6     x(i)=1 ;  
7 end
```

```
8 X=fft(x,-1);
```

Scilab code Exa 4.6 DFT computation

```
1 clc;
2 clear;
3 Wo=2*%pi/3;
4 n=-8:8;
5 for i=1:length(n)
6     x(i)=cos(Wo*n(i));
7 end
8 X=fft(x,-1);
```

Scilab code Exa 4.9 DFT computation

```
1 clc;
2 clear;
3 a=0.5;
4 b=0.25;
5 n=-10:10;
6 for i=1:length(n)
7     if n(i)<0 then
8         x(i)=0;
9         h(i)=0;
10    else
11        x(i)=b^n(i);
12        h(i)=a^n(i);
13    end
14 end
15 y=convol(x,h);
16 n1=-20:20;
17 plot2d3(n1,y)
```

Scilab code Exa 4.28 Circular convolution

```
1 //Ex 4.28
2 clc;
3 f1=[2,1,2,1];
4 f2=[1,2,3,4];
5 F1=fft(f1,-1);
6 F2=fft(f2,-1);
7 F=F1.*F2;
8 f=fft(F,1);
```

Scilab code Exa 4.29 Record Length

```
1 //Ex 4.29
2 clc;
3 fm=500;
4 fs=2*fm;
5 T=1/fs;
6 df=10;
7 N=2*fm/df;
8 rl=N*T;
9 disp(rl,'Record Length');
10 sl=0.05;
11 zp=rl-sl;
12 disp(zp,'Zero padding required');
```

Scilab code Exa 4.31 Sampling rate and DFT size

```
1 //Ex 4.31
```

```
2  clc;  
3  fm=10*103;  
4  df=100;  
5  N=2*fm/df;  
6  l=log2(N);  
7  l1=ceil(l);  
8  N1=2l1;  
9  fs=N1*df;  
10 disp(fs, 'Required Sampling Freq');
```

Scilab code Exa 4.32 DFT computation

```
1  //Ex 4.32  
2  clc;  
3  clear;  
4  f=[0 1 1 1 0 0];  
5  F=fft(f, -1);
```

Chapter 5

Sampling

Scilab code Exa 5.1 Minimum Sampling Frequency

```
1 //Ex 5.1
2 clc;
3 fmax=30;
4 fmin=20;
5 BW=fmax-fmin;
6 disp(BW, 'Bandwidth (kHz)');
7 mFs=2*BW;
8 disp(mFs, 'Minimum Sampling Frequency (kHz)');
```

Scilab code Exa 5.2.a Minimum Sampling Interval

```
1 //Ex 5.2 a
2 clc;
3 syms T;
4 disp('x(t)=1+cos(20*pi*t)');
5 w=20*pi;
6 f=w/(2*pi);
7 T=1/(2*f);
8 disp(T, 'minimum sampling interval');
```

Scilab code Exa 5.2.b Minimum Sampling Interval

```
1 //Ex 5.2b
2 clc;
3 disp('x(t)=(1/2*pi*t) [ sin(31*pi*t)-sin(29*pi*t) ] ');
4 w1=31*pi;
5 f1=w1/(2*pi);
6 w2=29*pi;
7 f2=w2/(2*pi);
8 if f1<f2 then
9     T=1/(2*f2);
10 else
11     T=1/(2*f1);
12 end
13 disp(T, 'minimun sampling interval');
```

Scilab code Exa 5.6 Continuous time Frequency

```
1 //Ex 5.6
2 clc;
3 ws=1000*pi;
4 w=ws/2;
5 disp(w, 'Cont. time Frequency w ( rad/seconed )');
```

Scilab code Exa 5.9 Aliasing

```
1 //Ex 5.9
2 clc;
3 disp('x(t)=cos(200*pi*t+theta)');
```

```
4 w=200*%pi;
5 f=w/(2*%pi);
6 nyquist_rate=2*f;
7 disp(nyquist_rate,'Minimum sampling frequency to
    avoid aliasing is');
```

Scilab code Exa 5.12 Find the frequency

```
1 omega=%pi/4;
2 T=10^(-3)
3 w=omega/T;
4 disp(w)
```

Scilab code Exa 5.14 Sampling period

```
1 [N,kerA]=linsolve(5*%pi/9,-2*%pi);
2 N1=floor(N);
3 disp(N1);
```

Chapter 6

Transformed Networks

Scilab code Exa 6.1 Current flowing in a network

```
1 //Ex 6.1
2 clc;
3 syms s;
4 v=10;
5 R=4;
6 L=2;
7 C=0.125;
8 V=laplace(v);
9 I=V/(R+L*s+(1/(C*s)));
10 i=ilaplace(I);
11 disp(i, 'i(t)=');
```

Scilab code Exa 6.2 voltage across inductor

```
1 //Ex 6.2
2 clc;
3 syms s;
4 i=4;
```



```

5 R=13/4;
6 L=1;
7 C=1/13;
8 I=laplace(i)+1;
9 Y=1/R+s/13+1/s;
10 V=I/Y;
11 v=ilaplace(V);
12 disp(v, 'v(t)=');

```

Scilab code Exa 6.3 voltage across capacitor

```

1 //Ex 6.3
2 clc;
3 syms s;
4 i=5;
5 R=2;
6 L=1;
7 C=1/2;
8 Z=((R+L*s)*(1/(C*s)))/((R+L*s)+(1/(C*s)));
9 V=Z*i;
10 v=ilaplace(V);
11 disp(v, 'v(t)=');

```

Scilab code Exa 6.9 Bode Plot

```

1 //Ex 6.9
2 //Obtain the Bode plot
3 clc;
4 s=poly(0, 's');
5 H=symlin('c', 8*(1+.1*s)/(s*(1+.5*s)*(1+.6*s/50+(s
    /50)^2)));

```

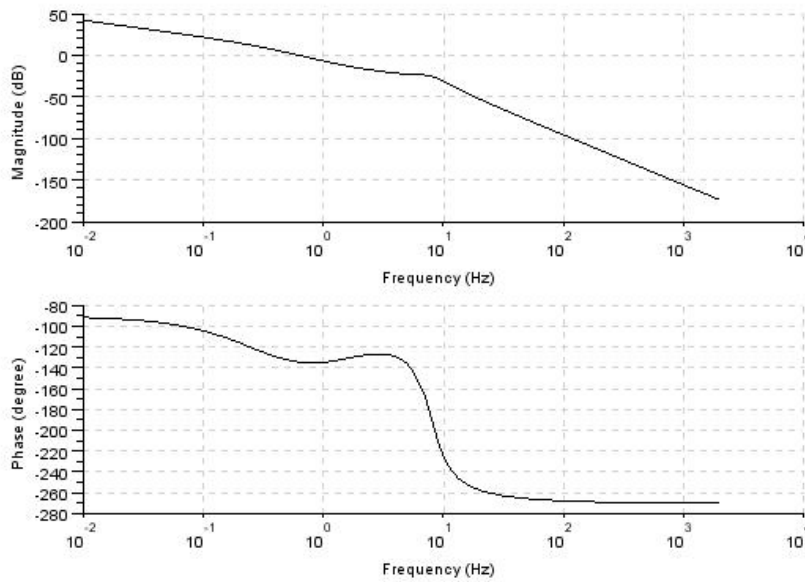


Figure 6.1: Bode Plot

6 `bode(H,0.01,2000);`

Scilab code Exa 6.10 Bode Plot

```

1 //Ex 6.10
2 //Obtain the Bode plot
3 clc;
4 H=symlin('c',10*(1+%s/2)/(%s*(1+%s/.1)*(1+%s/.5)*(1+
   %s/10)));
5 bode(H,0.01,100);

```

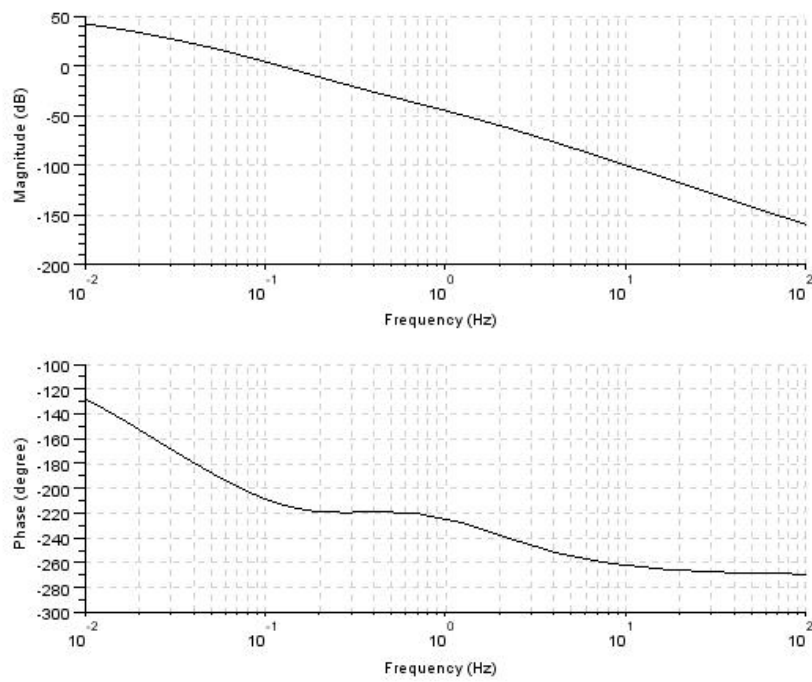


Figure 6.2: Bode Plot

Chapter 7

State Space Analysis

Scilab code Exa 7.1 State Space Representation

```
1 clc;  
2 close  
3 clear;  
4 s=%s;  
5 tf=syslin('c',((s+3)/(s^3+5*s^2+8*s+3)));  
6 ss=tf2ss(tf);  
7 disp(ss)
```

Scilab code Exa 7.2 State Space Representation

```
1 clc;  
2 close  
3 clear;  
4 s=%s;  
5 tf=syslin('c',((s+3)/((s+2)^2*(s+1))));  
6 ss=tf2ss(tf);  
7 disp(ss)
```

Chapter 8

Stability Analysis of LTI Systems

Scilab code Exa 8.1.a check for HURWITZ

```
1      clc;
2      // Define the polynomial
3      s=poly(0,"s");
4      p=10+9*s+4*s^2+s^3;
5      [C]=coeff(p);
6      l1=length(C);
7      x=0;
8      for i1=1:l1
9          r1=C(1,i1);
10         r1=real(r1);
11         if r1>0 then
12             x=x+1;
13         end
14     end
15     if(x==l1) then
16         [S]=roots(p);
17         disp(S,"Roots=");
18         l=length(S);
19         c=0;
```

```

20     for i=1:l
21         a=S(i,1);
22         r=real(a);
23         if r<0 then
24             c=c+1;
25         end
26     end
27     if(c==l) then
28         printf("Polynomial is Hurwitz");
29     else
30         printf("Polynomial is non-Hurwitz");
31     end
32 else
33     printf("Polynomial is non-Hurwitz");
34 end

```

Scilab code Exa 8.1.b check for HURWITZ

```

1     clc;
2     // Define the polynomial
3     s=poly(0,"s");
4     p=30+4*s+s^2+s^3;
5     [C]=coeff(p);
6     l1=length(C);
7     x=0;
8     for i1=1:l1
9         a1=C(1,i1);
10        r1=real(a1);
11        if r1>0
12            x=x+1;
13        end
14    end
15    if(x==l1) then
16        [S]=roots(p);
17        disp(S,"Roots=");

```

```

18     l=length(S);
19     c=0;
20     for i=1:l
21         a=S(i,1);
22         r=real(a);
23         if r<0 then
24             c=c+1;
25         end
26     end
27     if(c==l) then
28         printf("Polynomial is Hurwitz");
29     else
30         printf("Polynomial is non-Hurwitz");
31     end
32 else
33     printf("Polynomial is non-Hurwitz");
34 end

```

Scilab code Exa 8.2 checking stability

```

1     clc;
2     // Define the polynomial
3     s=poly(0,"s");
4     p=5+3*s+2*s^2+2*s^3+s^4+s^5;
5     // Calculate the routh of above polynomial
6     r=routh_t(p);
7     A=r(:,1);
8     c=0;
9     x=0;
10    for i=1:6
11        x=A(i,1);
12        if x<>0
13            c=c+1;
14        end
15    end

```

```

16     if(c>=1) then
17         printf("system is unstable");
18     else
19         printf("system is stable");
20     end

```

Scilab code Exa 8.3 checking stability

```

1     clc;
2     // Define the polynomial
3     s=poly(0,"s");
4     p=2+2*s+5*s^2+4*s^3+4*s^4+2*s^5+s^6;
5     // Calculate the routh of above polynomial
6     r=routh_t(p);
7     S=roots(p);
8     disp(r,"Routh array=");
9     disp(S,"Roots=");
10    A=r(:,1);
11    c=0;
12    x=0;
13    for i=1:6
14        x=A(i,1);
15        if x<0
16            c=c+1;
17        end
18    end
19    if(c>=1) then
20        printf("system is unstable");
21    else
22        l=length(S);
23        c=0;
24        for i=1:l
25            a=S(i,1);
26            r=real(a);
27            if r<0 then

```



```

28             c=c+1;
29         end
30     end
31     if c==0 then
32         printf("system is stable");
33     else
34         printf("system is unstable");
35     end
36
37 end

```

Scilab code Exa 8.4 checking stability

```

1     clc;
2     // Define the polynomial
3     s=poly(0,"s");
4     p=1+2*s+5*s^2+5*s^3+2*s^4;
5     // Calculate the routh of above polynomial
6     r=routh_t(p);
7     disp(r,"Routh array=");
8     A=r(:,1);
9     c=0;
10    x1=0;
11    eps=0;
12    for i=1:5
13        x1=A(i,1);
14        if x1<0
15            c=c+1;
16        end
17    end
18    if(c>=1) then
19        printf("system is unstable");
20    else
21        printf("system is stable");
22    end

```

23 `x=roots(p);`

Scilab code Exa 8.5 checking stability

```
1      clc;
2      // Define the polynomial
3      s=poly(0,"s");
4      p=36+12*s+12*s^2+3*s^3+s^4;
5      // Calculate the routh of above polynomial
6      r=routh_t(p);
7      disp(r,"Routh array=");
8      A=r(:,1);
9      c=0;
10     x=0;
11     for i=1:5
12         x=A(i,1);
13         if x<0
14             c=c+1;
15             end
16     end
17     if(c>=1) then
18         printf("system is unstable");
19         else
20             printf("system is stable");
21         end
22     x=roots(p);
```

Scilab code Exa 8.9 checking stability

```
1      clc;
2      // Define the polynomial
3      z=poly(0,"z");
4      p=5+3*z+2*z^2+2*z^3+z^4+z^5;
```

```
5 // Calculate the routh of above polynomial
6 r=routh_t(p);
```

Scilab code Exa 8.11 Stability of discrete time system

```
1 clc;
2 // Define the polynomial
3 //z=poly(0,'z');
4 //z^3 - 0.3*z^2 + .1*z - .1
5 //Put z=(1+r)/(1-r);
6 //Bilinear transformation
7 s=poly(0,'s');
8 p=.7+2.9*s+2.9*s^2+1.7*s^3;
9 // Calculate the routh of above polynomial
10 r=routh_t(p);
11 disp(r,"Routh array=");
12 A=r(:,1);
13     c=0;
14     x=0;
15     for i=1:3
16         x=A(i,1);
17         if x<0
18             c=c+1;
19         end
20     end
21     if(c>=1) then
22         printf("system is unstable");
23     else
24         l=length(S);
25         c=0;
26         for i=1:l
27             a=S(i,1);
28             r=real(a);
29             if r<0 then
30                 c=c+1;
```

```
31         end
32     end
33     if c==0 then
34         printf("system is stable");
35     else
36         printf("system is unstable");
37     end
38
39 end
```

Chapter 9

Analog and Digital Filter Design

Scilab code Exa 9.1 BPF

```
1 //Ex 9.1
2 //Band pass Filter Design
3 //a
4 clc;
5 w1=10*10^3;
6 w2=15*10^3;
7 wot=sqrt(w1*w2);
8 wbt=w2-w1;
9 s=%s;
10 w=poly(0, 'w');
11 wt=poly(0, 'wt');
12 wx=(wt^2-wot^2)/(wbt*wt);
13 disp(w);
14 //b
15 //Let n=2
16 hb2=1/(s^2+sqrt(2)*s+1);
17 hb21=horner(hb2, (%i*w));
18 disp(hb21);
19 hb22=horner(hb21, wx);
```

```
20 disp(hb22);
```

Scilab code Exa 9.2 Band Stop Filter

```
1 //Ex 9.2
2 //Band Stop Filter Design
3 //a
4 clc;
5 w1=1200;
6 w2=2000;
7 s=%s;
8 w=poly(0, 'w');
9 St=poly(0, 'St');
10 wc=1; //For normalised Prototype
11 wd1t=poly(0, 'wd1t');
12 wt1=2500;
13 wx1=(wt1*(w2-w1)*wd1t)/(-wt1^2+w2*w1);
14 wt2=400;
15 wx2=(wt2*(w2-w1)*wd1t)/(-wt2^2+w2*w1);
16 disp(w);
17 wx=wx1; // required attenuation to less
18 // than -3dB for wx > -0.5195wd1t
19 wd1t=wc/0.5195;
20 //b
21 //Let n=4
22 hb2=1/((s^2+.7654*s+1).*(s^2+1.8478*s+1));
23 hb21=horner(hb2, (%i*w));
24 disp(hb21);
25 hb22=horner(hb21, wx);
26 disp(hb22);
27 hb23=horner(hb22, -%i*St);
28 disp(hb23);
```

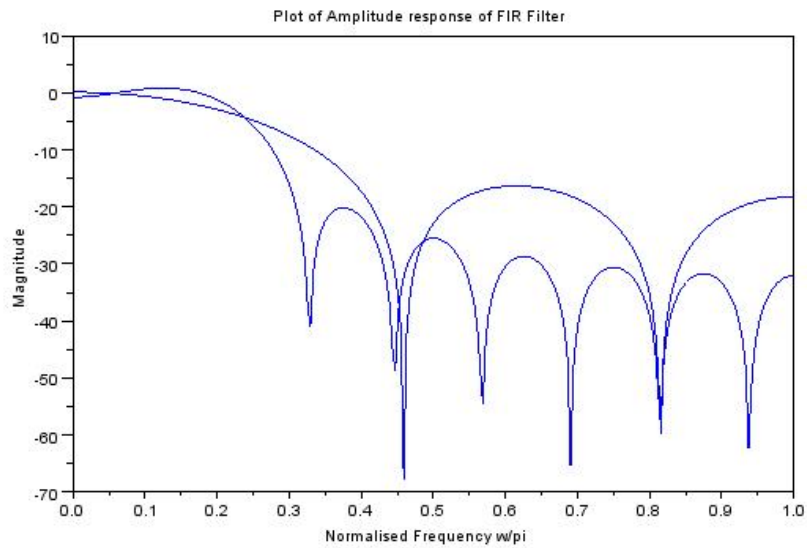


Figure 9.1: FIR Filter

Scilab code Exa 9.3 FIR Filter

```

1 //Ex 9.3
2 //FIR Filter
3 close;
4 clc;
5 //Fourier series method
6 //for N=5
7 N=5;
8 U=3;
9 for n=-2+U:1:2+U
10 if n==3
11 hd(n)=0.25;
12 else
13 hd(n)=sin(%pi*(n-U)/4)/(%pi*(n-U));

```

```

14 end
15 end
16 [hzm ,fr ]= frmag (hd ,256) ;
17 hzm_dB = 20* log10 (hzm)./ max ( hzm );
18 plot (2*fr , hzm_dB )
19
20 //for N=15
21 N=15;
22 U=8;
23 for n=-7+U:1:7+U
24     if n==8
25         hd(n)=0.25;
26     else
27         hd(n)=sin(%pi*(n-U)/4)/(%pi*(n-U));
28     end
29 end
30 [hzm ,fr ]= frmag (hd ,256) ;
31 hzm_dB = 20* log10 (hzm)./ max ( hzm );
32 plot (2*fr , hzm_dB )
33 xlabel('Normalised Frequency w/pi')
34 ylabel('Magnitude')
35 title('Plot of Amplitude response of FIR Filter')

```

Scilab code Exa 9.5 Low Pass Filter

```

1 //Ex 9.5
2 clc;
3 N=21;
4 U=11;
5 for n=-10+U:1:10+U
6     if n==11
7         hd(n)=0.25;
8     else

```

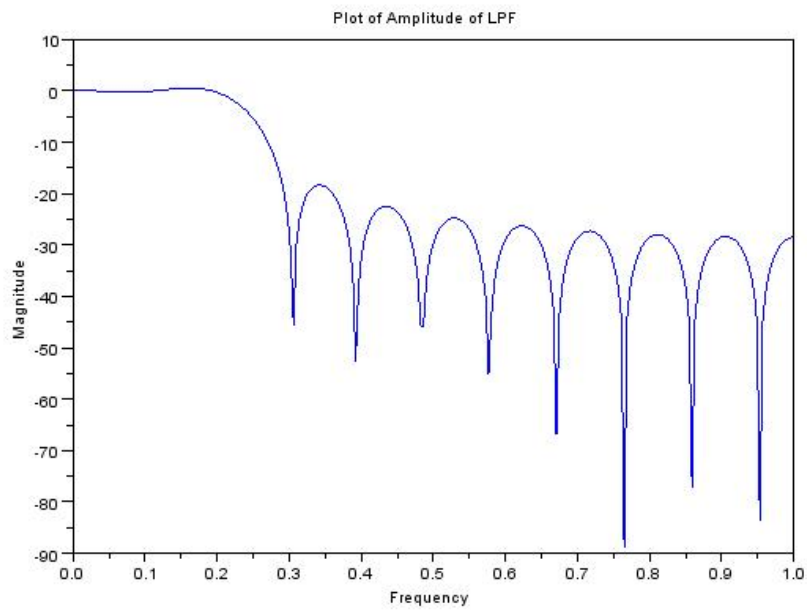



Figure 9.2: Low Pass Filter

```

9  hd(n)=(sin(%pi*(n-U)/4))/(%pi*(n-U));
10 end
11 end
12 [hzm ,fr ]= frmag (hd ,256) ;
13 hzm_dB = 20* log10 (hzm)./ max ( hzm );
14 plot (2*fr , hzm_dB );
15 xlabel ( 'Frequency' );
16 ylabel ( 'Magnitude' );
17 title('Plot of Amplitude of LPF')

```

Scilab code Exa 9.7 2nd order Digital Butterworth Filter

```

1 //Ex 9.7
2 clc;
3 s=%s;
4 T=10^(-4);
5 wdc=2*%pi*10^3;
6 wac=2/T*tan(wdc*T/2);
7 HS=1/(s^2+sqrt(2)*s+1) // Transfer Function for N=1
8 HS1=horner(HS ,s/wac);
9 disp(HS1 , 'Normalized Transfer Function , H(s) =');
10 z=%z;
11 HZ=horner(HS1 ,(2/T)*(z-1)/(z+1));
12 disp(HZ , 'H(z) =');

```

Chapter 10

MATLAB Tools for Analysis of Signals and systems

Scilab code Exa 10.1 Solving Linear Equation

```
1 clc;  
2 A=[2 1; 1 2]  
3 B=[1; 0]  
4 A=inv(A);  
5 X=A*B;
```

Scilab code Exa 10.3 Find the step and impulse response

```
1 clc;  
2 s=poly(0, 's');  
3 x=syslin('c', %s/(%s+2));
```

Scilab code Exa 10.9 Find the impulse response

```

1 //Ex 10.9
2 //Impulse response
3 num=[1 3];
4 den=[1 3 2];
5 n=0:1:20;
6 x=[1 zeros(1,20)];
7 y=filter(num,den,x);
8 plot(n,y);

```

Scilab code Exa 10.12 Find convolution and plot the result

```

1 //Ex 1012
2 //Convolution of two sequences
3 //[1 1 1 1 1]
4 //[1 2 3]
5 clc;
6 n1=0:1:4;
7 n2=0:1:2;
8 x=[1 1 1 1 1]
9 h=[1 2 3]
10 y=convol(x,h);
11 l=length(y);
12 n3=0:1:l-1;
13 figure
14 title('Sequence x')
15 plot2d3(n1,x);
16 figure
17 title('Sequence h')
18 plot2d3(n2,h);
19 figure
20 title('Sequence y')
21 plot2d3(n3,y);

```

Scilab code Exa 10.13 Find the step response

```
1 //Ex 1013
2 //Convolution of two sequences
3 //To plot the step response
4 // [.25 .25 .25 .25]
5 // [.25 -.25 .25 -.25]
6 clc;
7 n1=0:1:8;
8 n2=0:1:8;
9 h1=[0 0 0 .25 .25 .25 .25 0 0]
10 h2=[0 0 0 .25 -.25 .25 -.25 0 0]
11 y=convol(h1,h2);
12 l=length(y);
13 n3=0:1:l-1;
14 figure
15 title('Sequence h1')
16 plot2d3(n1,h1);
17 figure
18 title('Sequence h2')
19 plot2d3(n2,h2);
20 figure
21 title('Sequence y')
22 plot2d3(n3,y);
```
