1-DTFT

```
clc;
clear all;
close all;
xn=input('Enter the sequence x(n)');
ln=length(xn);
xk=zeros(1,ln);
ixk=zeros(1,ln);
for k=0:ln-1
  for n=0:ln-1
    xk(k+1)=xk(k+1)+(xn(n+1)*exp((i)*2*pi*k*n/ln));
  end
end
t=0:ln-1;
subplot(221);
stem(t,xn);
xlabel('Time Index');
ylabel('Amplitude');
title('Input Sequence');

magnitude=abs(xk);
t=0:ln-1;
subplot(222);
stem(t,magnitude);
xlabel('K');
ylabel('Amplitude');
title('Magnitude Response');

phase=angle(xk);
t=0:ln-1;
subplot(223);
```

```
stem(t,phase);
ylabel('Phase');
xlabel('K');
title('Phase Response');

 for n=0:ln-1
 for k=0:ln-1
  ixk(n+1)=ixk(n+1)+(xk(k+1)*exp(i*2*pi*k*n/ln));
  end
 end
 ixk=ixk/ln;
 t=0:ln-1;
 subplot(224);
 stem(t,xn);[
 xlabel('time');
 ylabel('inverse');
 title('Inverse Sequence');
```

2-find freq response

```
clc;
clear all;
close all;
b=input('ENTER THR NUMERATOR COFFICIENT');
a=input('ENTER THE DENOMINATOR COFFICIENT');
[h,w]=freqz(b,a);
subplot(2,1,1);
plot(w/pi,abs(h));
grid;
xlabel('NORMALISED FREQUENCY ');
ylabel('Magnitude in dB');
```

```
title('Magnitude rersponse');
subplot(2,1,2);
plot(w/pi,angle(h));
grid;
xlabel('NORMALISED FREQUENCY ');
ylabel('phase in radians');
title('phase response');
```

3-POLES and ZEROS

```
clc;
clear all;
close all;
pkg load control;
x=[2,5,1];
y=[1,3,5];
system-tf(x,y); figure;
pzmap(system);
title("Poles and zeros");
 grid on;
poles = roots(y);
zeros = roots(x);
 disp("Poles");
disp(poles);
disp("Zeros");
 disp(zeros);
```

4-linear convolution

```
clc;
clear all;
close all;
x = input('Enter the input signal x(n) : ');
h = input('Enter the impulse response h(n) a: ');
```

```
M = length(x);
N = length(h);
if M < N
x = [x, zeros(1,N - M)];
elseif N < M
h = [h, zeros(1, M - N)];
end
y_formula = zeros(1, M + N - 1);
for n = 1:(M + N - 1)
for k = max(1, n - N + 1):min(M, n)
  y_formula(n) = y_formula(n) + x(k) * h(n - k + 1);
end
end
subplot(3, 3, 1);
stem(x ,'filled');
title('Input');
xlabel('n');
ylabel('y(n)');
subplot(3, 3, 2);
stem(h, 'filled');
title('Impulse');
xlabel('n');
ylabel('y(n)');
subplot(3, 3, 3);
stem(y_formula, 'filled');
title('Linear Convolution (Formula Method)');
xlabel('n');
ylabel('y(n)');
```

5-To obtain responses for diff eqn

```
clc;
clear all;
close all;

N = input('Enter the length of response: ');
b = input('Enter the coefficients of x(n) as a row vector: ');
a = input('Enter the coefficients of y(n) as a row vector: ');

% To find the impulse response
figure(1);
X_impulse = [1, zeros(1, N-1)];
n = 0:1:N-1;
h_impulse = filter(b, a, X_impulse);
disp('Impulse response of filter=');
disp(h_impulse);
subplot(2,1,1);
stem(n, X_impulse);
title('Impulse Input');
xlabel('n');
ylabel('x(n)');

subplot(2,1,2);
stem(n, h_impulse);
title('Impulse Response');
xlabel('n');
ylabel('h(n)');

% To find the step response
figure(2);
X_step = ones(1, N);
```

```
h_step = filter(b, a, X_step);
disp('Step response of filter=');
disp(h_step);

subplot(2,1,1);
stem(n, X_step);
title('Step Input');
xlabel('n');
ylabel('x(n)');

subplot(2,1,2);
stem(n, h_step);
title('Step Response');
xlabel('n');
ylabel('h(n)');

% To find the exponential response
figure(3);
n_exp = 0:1:N-1;
X_exp = 2.^n_exp;
h_exp = filter(b, a, X_exp);
disp('Exponential response of filter=');
disp(h_exp);

subplot(2,1,1);
stem(n_exp, X_exp);
title('Exponential Input');
xlabel('n');
ylabel('x(n)');

subplot(2,1,2);
```

```
stem(n_exp, h_exp);
title('Exponential Response');
xlabel('n');
ylabel('h(n)');

% To find the steady-state response
figure(4);
n_steady = 0:1:N-1;
X_steady = cos(0.5*pi*n_steady);
h_steady = filter(b, a, X_steady);
disp('Steady-state response of filter=');
disp(h_steady);

subplot(2,1,1);
stem(n_steady, X_steady);
title('Steady Input');
xlabel('n');
ylabel('x(n)');

subplot(2,1,2);
stem(n_steady, h_steady);
title('Steady-State Response');
xlabel('n');
ylabel('h(n)');
```

Sampling

```
clc;
close all;
clear all;
f1 = input('Enter the first sine wave frequency = ');
```

```
f2= input('Enter the second sine wave frequency = ');

fn = 2*max(f1,f2);

fs = fn/2;

t = [0:1/fs:0.1];

x = cos(2*pi*f1*t)+cos(2*pi*f2*t);

xk = fft(x);

f = [0:length(xk)-1]*fs/length(xk);

figure(1);

plot(f,abs(xk));

xlabel('frequency');

ylabel('amplitude');

title('Under Sampling');

grid;

fs = fn;

t = [0:1/fs:0.1];

x = cos(2*pi*f1*t)+cos(2*pi*f2*t);

xk = fft(x);

f = [0:length(xk)-1]*fs/length(xk);

figure(2);

plot(f,abs(xk));

xlabel('frequency');

ylabel('amplitude');

title('Nyquist Rate Sampling');

grid;

fs = 2*fn;

t = [0:1/fs:0.1];

x = cos(2*pi*f1*t)+cos(2*pi*f2*t);

xk = fft(x);

f = [0:length(xk)-1]*fs/length(xk);

figure(3);

plot(f,abs(xk));
```

```
xlabel('freq');
ylabel('amplitude');
title('Over Sampling');
grid;
```

7-Implement FIR (REct)

```
clc;
close all;
clear all;
pkg load signal;
fp = [200];
fs = [500];
rp = [0.001];
rs = [0.005];
f = [2000];
wp = 2*fp/f;
ws = 2*fs/f;
num = -20*log10(sqrt(rp*rs))-13;
den = 14.6*(fs-fp)/f;
n = ceil(num/den);
if(rem(n,2)~=0)
  n1 = n;n=n-1;
else
  n1 = n+1;
end
y = boxcar(n1);
b = fir1(n, wp, 'high', y);
[h, w] = freqz(b, 1, 256);
%magnitude response
m = 20*log10(abs(h));
subplot(2,4,1);
```

```
plot(w/pi, m);
xlabel('Normalized frequency');
ylabel('gain in dB');
title('Magnitude response(HPF)');
grid on;
%phase response
p = angle(h);
subplot(2,4,2);
plot(w/pi, p);
xlabel('Normalized frequency');
ylabel('degree');
title('Phase response(HPF)');
grid on;

b = fir1(n, ws, 'low', y);
[h, w] = freqz(b, 1, 256);

%magnitude response
m = 20 * log10(abs(h));
subplot(2, 4, 3);
plot(w/pi, m);
xlabel('Normalized frequency');
ylabel('gain in dB');
title('Magnitude response(LPF)');
grid on;

%phase response
phi = angle(h);
subplot(2, 4, 4);
plot(w/pi, phi);
xlabel('Normalized frequency');
```

```
ylabel('degree');
title('Phase response(LPF)');
grid on;

wn = [wp, ws];
b = fir1(n, wn, 'pass', y);
[h, w] = freqz(b, 1, 256);

%magnitude response
m = 20 * log10(abs(h));
subplot(2, 4, 5);
plot(w/pi, m);
xlabel('Normalized frequency');
ylabel('gain in dB');
title('Magnitude response(BPF)');
grid on;
%phase response
phi = angle(h);
subplot(2, 4, 6);
plot(w/pi, phi);
xlabel('Normalized frequency');
ylabel('degree');
title('Phase response(BPF)');
grid on;

b = fir1(n, wn, 'stop', y);
[h, w] = freqz(b, 1, 256);

%magnitude response
m = 20 * log10(abs(h));
subplot(2, 4, 7);
```

```
plot(w/pi, m);

xlabel('Normalized frequency');

ylabel('gain in dB');

title('Magnitude response(BSF)');

grid on;


%phase response

phi = angle(h);

subplot(2, 4, 8);

plot(w/pi, phi);

xlabel('Normalized frequency');

ylabel('degree');

title('Phase response(BSF)');
```

8-frequency sampling method (FIR)

```
clc;clear all;

close all;

N=input('enter the order of the filter N=');

alpha=(N-1)/2;

Hrk=[ones(1,2),zeros(1,4),ones(1,1)];

k1=0:(N-1)/2;k2=(N+1)/2:N-1;

theetak=[(-alpha*(2*pi)/N)k1,(alpha(2*pi)/N)(N-k2)];

Hk=Hrk.(exp(i*theetak));w=0:0.01:pi;

hn=real(ifft(Hk,N)) H=freqz(hn,1,w);

plot(w/pi,20*log10(abs(H))) ylabel('magnitude in db');

xlabel('normalised frequency');


clc;
```

```
clear all;
close all;
pkg load signal;

Fp = 200;
Fs = 500;
Sf = 2000;
Pbr = 0.001;
Sbr = 0.005;

Wp = 2*Fp/Sf;
Ws = 2*Fs/Sf;

[n, Wc] = buttord(Wp, Ws, Pbr, Sbr);

% Low Pass
[b, a] = butter(n, Wc, 'low');
[y, t] = impz(b, a, 60);
subplot(4, 3, 3);
stem(t, y);
xlabel("Time");
ylabel("Impulse");
title("Impulse Response Low Pass");

w = 0:0.01:pi;
[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(4, 3, 1);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
```

```
title("Magnitude Response Low Pass");

subplot(4, 3, 2);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response Low Pass");

% High Pass
[b, a] = butter(n, Wc, 'high');
[y, t] = impz(b, a, 60);
subplot(4, 3, 6);
stem(t, y);
xlabel("Time");
ylabel("Impulse");
title("Impulse Response High Pass");

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(4, 3, 4);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response High Pass");

subplot(4, 3, 5);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response High Pass");
```

```
% Band Pass
Wn = [Wp, Ws];
[b, a] = butter(n, Wn, 'bandpass');
[y, t] = impz(b, a, 60);
subplot(4, 3, 9);
stem(t, y);
xlabel("Time");
ylabel("Impulse");
title("Impulse Response Band Pass");

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(4, 3, 7);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response Band Pass");

subplot(4, 3, 8);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response Band Pass");

% Band Stop
[b, a] = butter(n, Wn, 'stop');
[y, t] = impz(b, a, 60);
subplot(4, 3, 12);
stem(t, y);
xlabel("Time");
ylabel("Impulse");
```

```
title("Impulse Response Band Stop");

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(4, 3, 10);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response Band Stop");

subplot(4, 3, 11);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response Band Stop");
```

EXP-9

```
clc;
clear all;
close all;
pkg load signal;

Fp = 2000;
Fs = 5000;
Sf = 20000;
Pbr = 10;
Sbr = 20;

Wp = 2*Fp/Sf;
```

```
Ws = 2*Fs/Sf;

[n, Wp] = cheb1ord(Wp, Ws, Pbr, Sbr);
w = 0:0.01:pi;
% Low Pass
[b, a] = cheby1(n, Pbr, Wp,'low');

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(3, 3, 1);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response Low Pass");

subplot(3, 3, 2);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response Low Pass");

% High Pass
[b, a] = cheby1(n, Pbr, Wp, 'high');

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(3, 3, 3);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response High Pass");
```

```
subplot(3, 3, 4);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response High Pass");

% Band Pass
Wn = [Wp, Ws];
[b, a] = cheby1(n, Pbr, Wn, 'pass');

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(3, 3, 5);
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response Band Pass");

subplot(3, 3, 6);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response Band Pass");

% Band Stop
[b, a] = cheby1(n,Pbr,Wn, 'stop');

[h, o] = freqz(b, a, w);
m1 = 20*log10(abs(h));
subplot(3, 3, 7);
```

```
plot(o/pi, m1);
xlabel("Frequency");
ylabel("Gain(dB)");
title("Magnitude Response Band Stop");

subplot(3, 3, 8);
plot(o/pi, angle(h));
xlabel("Frequency");
ylabel("Gain(dB)");
title("Phase Response Band Stop");
```

EXP-10

```
clc;
close all;
clear all;

x1 = [1 2 3 4 5 6 7 8 9 10];
x2 = [10 9 8 7 6 5 4 3 2 1];
ln = length(x1); % Find the length of the sequence

ln = length(x2);
% FFT of the sequence
xk = fft(x1);
yk = fft(x2);
% Plotting input sequence
t = 0:ln-1;
subplot(241);
stem(t, x1);
ylabel('Amplitude');
xlabel('Time Index');
title('Input Sequence');
```

```
subplot(245);
stem(t, x2);
ylabel('Amplitude');
xlabel('Time Index');
title('Input Sequence');

% Magnitude response
magnitude = abs(xk);
subplot(242);
stem(t, magnitude);
ylabel('Amplitude');
xlabel('K');
title('Magnitude Response');

magnitude = abs(yk);
subplot(246);
stem(t, magnitude);
ylabel('Amplitude');
xlabel('K');
title('Magnitude Response');

% Phase response
phase1 = angle(xk);
subplot(243);
stem(t, phase1);
ylabel('Phase');
xlabel('K');
title('Phase Response');

phase2 = angle(yk);
```

```
subplot(247);
stem(t, phase2);
ylabel('Phase');
xlabel('K');
title('Phase Response');

% IFFT of the sequence
ixk = ifft(x1) / ln;

% Plotting IDFT sequence
subplot(244);
stem(t, ixk);
ylabel('Amplitude');
xlabel('Time Index');
title('IDFT Sequence');


iyk = ifft(x2) / ln;

% Plotting IDFT sequence
subplot(248);
stem(t, iyk);
ylabel('Amplitude');
xlabel('Time Index');
title('IDFT Sequence');
```

5-input

```
clc;
close all;
clear all;
```

```
x1 = [1 2 3 4 5 ];
x2 = [1 2 3 4 5 6 7 8 9 10];
ln1 = length(x1); % Find the length of the sequence

ln2 = length(x2);
% FFT of the sequence
xk = fft(x1);
yk = fft(x2);
% Plotting input sequence
t1 = 0:ln1-1;
subplot(241);
stem(t1, x1, 'Color', [0.5 0 0], 'LineWidth', 1.5);
ylabel('Amplitude');
xlabel('Time Index');
title('Input Sequence');
t2 = 0:ln2-1;
subplot(245);
stem(t2, x2, 'Color', [0 0.5 0], 'LineWidth', 1.5);
ylabel('Amplitude');
xlabel('Time Index');
title('Input Sequence');

% Magnitude response
magnitude = abs(xk);
subplot(242);
stem(t1, magnitude, 'Color', [0 0 0.5], 'LineWidth', 1.5);
ylabel('Amplitude');
xlabel('K');
title('Magnitude Response');

magnitude = abs(yk);
```

```
subplot(246);
stem(t2, magnitude, 'Color', [0.5 0.5 0], 'LineWidth', 1.5);
ylabel('Amplitude');
xlabel('K');
title('Magnitude Response');

% Phase response
phase1 = angle(xk);
subplot(243);
stem(t1, phase1, 'Color', [0.8 0 0.8], 'LineWidth', 1.5);
ylabel('Phase');
xlabel('K');
title('Phase Response');

phase2 = angle(yk);
subplot(247);
stem(t2, phase2, 'Color', [0 0.8 0.8], 'LineWidth', 1.5);
ylabel('Phase');
xlabel('K');
title('Phase Response');

% IFFT of the sequence
ixk = ifft(x1) / ln1;

% Plotting IDFT sequence
subplot(244);
stem(t1, ixk, 'Color', [0.2 0.2 0.2], 'LineWidth', 1.5);
ylabel('Amplitude');
xlabel('Time Index');
title('IDFT Sequence');
```

```
iyk = ifft(x2) / ln2;

% Plotting IDFT sequence
subplot(248);
stem(t2, iyk, 'Color', [0.5 0.5 0.5], 'LineWidth', 1.5);
ylabel('Amplitude');
xlabel('Time Index');
title('IDFT Sequence');
```