# 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');

## 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');

1. **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);

## 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)');

## 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');