%EXPERIMENT-4

% PROGRAM FOR THE DESIGN OF FIR LPF, HPF, BPF & BSF USING RECTANGULAR WINDOW

%Enter the Pass Band Ripple: .05

%Enter the Stop Band Ripple: .04

%Enter the Pass Band Frequency: 1500

%Enter the Stop Band Frequency: 2000

%Enter the Sampling Frequency: 8000

%We want to design a Discrete Time Low Pass Filter for a voice signal. The specifications are:

%Passband fp=1500 Hz, with 0.05dB ripple;

%Stopband fs=2000 Hz, with 50dB attenuation and with 0.04dB ripple;

%Sampling Frequency f=8000 Hz.

%Recall the mapping from analog to digital frequency normalised passband fequency is given by wp = 2\*fp/f, and normalised stopband fequency is given by ws = 2\*fp/f with f as the sampling frequency.

clc; close all; clear all;

rp = input('Enter the Pass Band Ripple: ');

rs = input('Enter the Stop Band Ripple: ');

fp = input('Enter the Pass Band Frequency: ');

fs = input('Enter the Stop Band Frequency: ');

f = input('Enter the Sampling Frequency: ');

wp = 2 \* fp/f;

ws = 2 \* fs/f;

num = - 20 \* log(sqrt(rp\*rs))- 13;

den = 14.6 \* (fs-fp)/f;

n = ceil (num/den) ;

n1 = n+1;

if(rem(n,2)~=0)

n1 = n;

n = n-1;

end

y = boxcar (n1) ;

disp('Filter ordern n= ');n

% LOW PASS FILTER

b = fir1(n,wp,y);

[h,w] = freqz(b,1,256);

%[h,w] = freqz(b,a,n) returns the n-point frequency response vector h and the corresponding angular frequency vector w for the digital filter with transfer function coefficients stored in b and a.

%Ref: https://in.mathworks.com/help/signal/ref/freqz.html

m = 20 \* log(abs(h));

subplot(2,2,1) ;

plot (w/pi,m) ;

title(' \*\*\*\*\* RECTANGULAR WINDOW or BOXCAR \*\*\*\*\*');

ylabel('Gain indb------>');xlabel(' (a) Normalised Frequency------->');

% HIGH PASS FILTER

b = fir1(n,wp,'high',y);

[h,w] = freqz(b,1,256);

m = 20\*log(abs(h));

subplot(2,2,2);

plot(w/pi,m);

ylabel('Gain in db------>');

xlabel(' (b) Normalised Frequency------->');

% BAND PASS FILTER

wn = [wp ws];

b = fir1(n,wn,y);

[h,w] = freqz(b,1,256);

m = 20\*log(abs(h));

subplot(2,2,3) ;

plot (w/pi, m) ;

ylabel('Gain in db------>');

xlabel(' (c) Normalised Frequency------->');

% BAND STOP FILTER

b = fir1(n,wn,'stop',y);

[h,w] = freqz(b,1,256);

m = 20\*log(abs(h));

subplot(2,2,4) ;

plot (w/pi, m) ;

ylabel('Gain in db------>');

xlabel(' (d) Normalised Frequency------->');