**DESIGN OF FIR FILTERS**

**LOW PASS FIR FILTER**

MATLAB code:-

clc;clear all;close all;

wc=0.5\*pi;

N=11;

e=0.001;

n=-(N-1)/2:1:(N-1)/2;

hd1=(sin(wc\*(n+e)))./(pi\*(n+e));

wr=boxcar(N);

hm1=hd1.\*wr';

w=0:0.01:pi;

h1=freqz(hm1,1,w);

subplot(2,2,1);

plot(w/pi,abs(h1),'-');

grid;

xlabel('normalised frequency');

ylabel('magniutde');

title('FIR low pass filter magnitude using rectangular window');

subplot(2,2,2);

plot(w/pi,angle(h1),'-');

grid;

xlabel('normalised frequency');

ylabel('phase angle');

title('FIR low pass filter phase using rectangular window');

wh=hamming(N);

hm2=hd1.\*wh';

h2=freqz(hm2,1,w);

subplot(2,2,3);

plot(w/pi,abs(h2),'-');

grid;

xlabel('normalised frequency');

ylabel('phase angle');

title('FIR low pass filter magnitude using hamming window');

subplot(2,2,4);

plot(w/pi,angle(h2),'-');

grid;

xlabel('normalised frequency');

ylabel('phase angle');

title('FIR low pass filter phase using hamming window');

**HIGH PASS FIR FILTER**

MATLAB code:-

clc;clear all;close all;

wc=0.5\*pi;

N=11;

e=0.001;

n=-(N-1)/2:1:(N-1)/2;

hd1=(sin(pi\*(n+e))-sin(wc\*(n+e)))./(pi\*(n+e));

wr=boxcar(N);

hm1=hd1.\*wr';

w=0:0.01:pi;

h1=freqz(hm1,1,w);

subplot(2,2,1);

plot(w/pi,abs(h1),'-');

grid;

xlabel('normalised frequency');

ylabel('magniutde');

title('FIR HIGH pass filter magnitude using rectangular window');

subplot(2,2,2);

plot(w/pi,angle(h1),'-');

grid;

xlabel('normalised frequency');

ylabel('phase angle');

title('FIR HIGH pass filter phase using rectangular window');

wh=hamming(N);

hm2=hd1.\*wh';

h2=freqz(hm2,1,w);

subplot(2,2,3);

plot(w/pi,abs(h2),'-');

grid;

xlabel('non frequency');

ylabel('phase angle');

title('FIR HIGH pass filter magnitude using hamming window');

subplot(2,2,4);

plot(w/pi,angle(h2),'-');

grid;

xlabel('normalised frequency');

ylabel('phase angle');

title('FIR HIGH pass filter phase using hamming window');

**BANDPASS FIR FILTER**

MATLAB code:-

clc;clear all;close all;

wc1=0.25\*pi;

wc2=0.75\*pi;

N=25;

e=0.001;

a=(N-1)/2;

n=0:1:N-1;

hd=(sin(wc2\*(n-a+e))-sin(wc1\*(n-a+e)))./(pi\*(n-a+e));

wr=boxcar(N);

hn=hd.\*wr';

w=0:0.01:pi;

h=freqz(hn,1,w);

subplot(2,1,1);

plot(w/pi,abs(h));

grid;

xlabel('normalized frequency');

ylabel('magnitude');

title('BAND PASS FILTER using Rectangular window');

wh=hamming(N);

hn=hd.\*wh';

w=0:0.01:pi;

h=freqz(hn,1,w);

subplot(2,1,2);

plot(w/pi,abs(h));

grid;

xlabel('normalized frequency');

ylabel('magnitude');

title('BAND PASS FILTER using Hamming window');



**BAND REJECT FIR FILTER**

MATLAB code:-

clc;clear all;close all;

wc1=0.25\*pi;

wc2=0.75\*pi;

N=25;

e=0.001;

a=(N-1)/2;

n=0:1:N-1;

hd=(sin(wc1\*(n-a+e))-sin(wc2\*(n-a+e))+sin(pi\*(n-a+e)))./(pi\*(n-a+e));

wr=boxcar(N);

hn=hd.\*wr';

w=0:0.01:pi;

h=freqz(hn,1,w);

subplot(2,1,1);

plot(w/pi,abs(h));

grid;

xlabel('normalized frequency');

ylabel('magnitude');

title('BAND REJECT FILTER using Rectangular window');

wh=hamming(N);

hn=hd.\*wh';

w=0:0.01:pi;

h=freqz(hn,1,w);

subplot(2,1,2);

plot(w/pi,abs(h));

grid;

xlabel('normalized frequency');

ylabel('magnitude');

title('BAND REJECT FILTER using Hamming window');

