**EXPERIMENT NO: 05**

**BUTTERWORTH FILTER DESIGN USING MATLAB**

**AIM:** To design butterworth low pass, high pass, bandpass, bandstop filter using matlab.

**SOFTWARE USED**: MATLAB Ver:8.6(R2015b).

**PROGRAM:**

% To design butterworth low pass, high pass, bandpass, bandstop filter using matlab

clc;

close all;

clear all;

rp=input('enter the passband ripple: ');

rs=input('enter the stopband ripple: ');

wp=input('enter the passband freq: ');

ws=input('enter the stopband freq: ');

fs=input('enter the sampling freq: ');

w1=2\*wp/fs;

w2=2\*ws/fs;

[n,wn]=buttord(w1,w2,rp,rs)

%LOW PASS FILTER

[b,a]=butter(n,wn,'low');

w=0:0.01:pi;

[h,om]=freqz(b,a,w);

m=20\*log10(abs(h));

an=angle(h);

subplot(4,2,1);

plot(om/pi,m);

ylabel('Gain in dB');

xlabel('(a) Normalised Frequency');

title('Low pass Filter');

subplot(4,2,2)

plot(om/pi,an);

ylabel('Gain in dB');

xlabel('Phase in radians');

title('Low pass Filter');

%HIGH PASS FILTER

[b,a]=butter(n,wn,'high');

w=0:0.01:pi;

[h,om]=freqz(b,a,w);

m=20\*log10(abs(h));

an=angle(h);

subplot(4,2,3);

plot(om/pi,m);

ylabel('Gain in dB');

xlabel('(a) Normalised Frequency');

title('High pass Filter');

subplot(4,2,4)

plot(om/pi,an);

ylabel('Gain in dB');

xlabel('Phase in radians');

title('High pass Filter');

%BAND PASS FILTER

[n]=buttord(w1,w2,rp,rs);

wn=[w1 w2];

[b,a]=butter(n,wn,'bandpass');

w=0:0.01:pi;

[h,om]=freqz(b,a,w);

m=20\*log10(abs(h));

an=angle(h);

subplot(4,2,5);

plot(om/pi,m);

ylabel('Gain in dB');

xlabel('(a) Normalised Frequency');

title('Band pass Filter');

subplot(4,2,6)

plot(om/pi,an);

ylabel('Gain in dB');

xlabel('Phase in radians');

title('Band pass Filter');

%BAND STOP FILTER

[n]=buttord(w1,w2,rp,rs);

wn=[w1 w2];

[b,a]=butter(n,wn,'stop');

w=0:0.01:pi;

[h,om]=freqz(b,a,w);

m=20\*log10(abs(h));

an=angle(h);

subplot(4,2,7);

plot(om/pi,m);

ylabel('Gain in dB');

xlabel('(a) Normalised Frequency');

title('Band stop Filter');

subplot(4,2,8)

plot(om/pi,an);

ylabel('Gain in dB');

xlabel('Phase in radians');

title('Band stop Filter');

gtext('name');

**OUTPUT:**





