Department of Electronic and Telecommunication Engineering

University of Moratuwa, Sri Lanka

EN2063 — SIGNALS AND SYSTEMS

Digital Filter Design

Semester 03 : Project

Submitted by

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Specifications

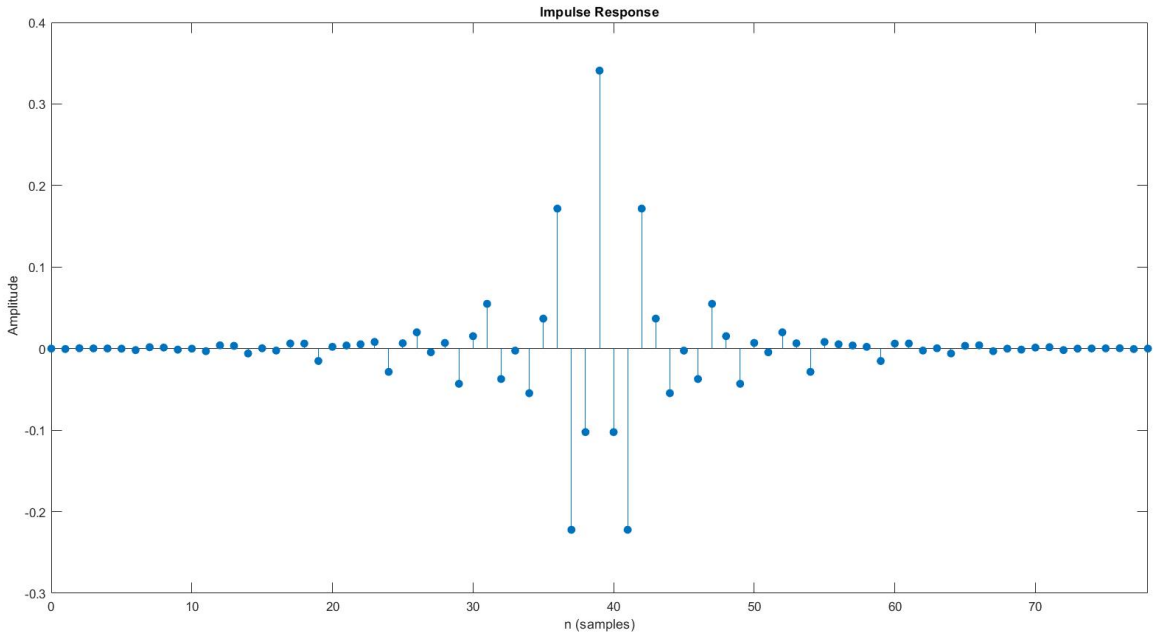
Index Number : 200087A (200ABC.)
A = 0 , B = 8 , C = 7
D = 7 mod 4 = 3

Parameters

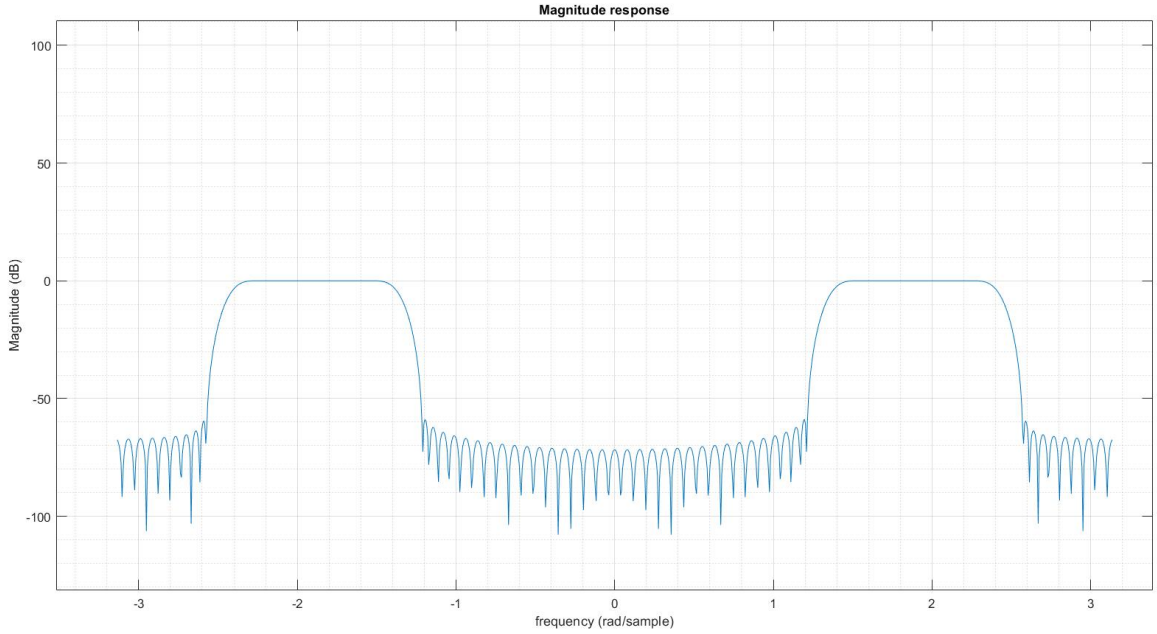
Maximum passband ripple = 0.1 dB
Minimum stopband attenuation = 58 dB
Lower passband edge = 1100 rad/s
Upper passband edge = 1600 rad/s
Lower stopband edge = 800 rad/s
Upper stopband edge = 1800 rad/s
Sampling frequency = 4400 rad/s

1 FIR Bandpass Digital Filter

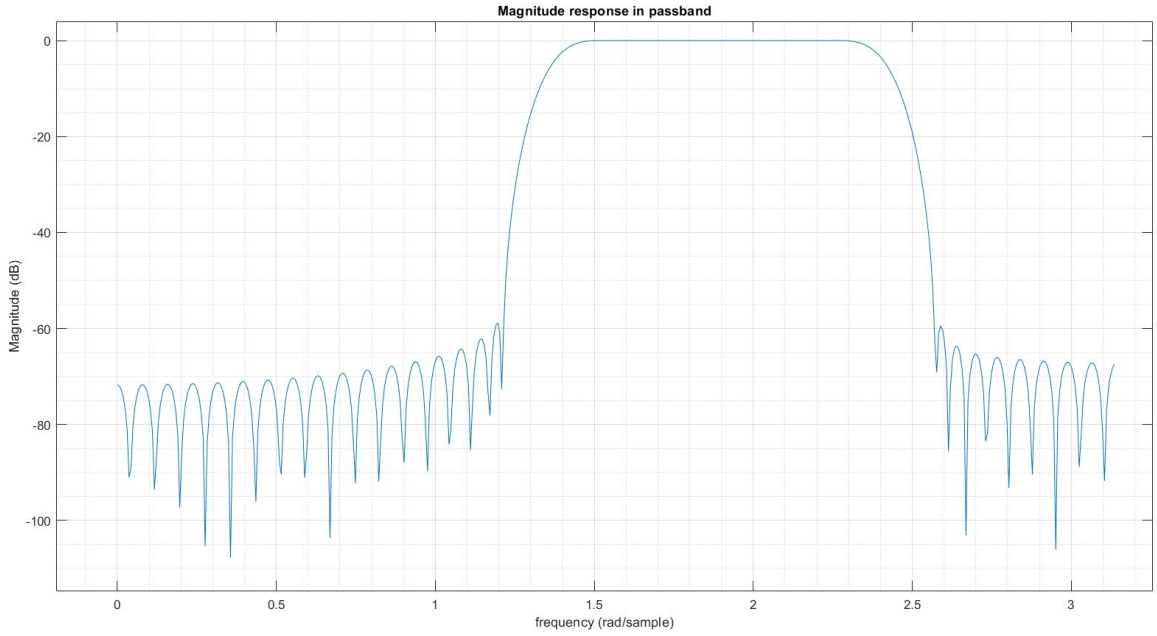
1.1 Impulse Response



1.2 Magnitude Response of the Digital Filter



1.3 Magnitude Response in the Passband



2 IIR Bandpass Filter

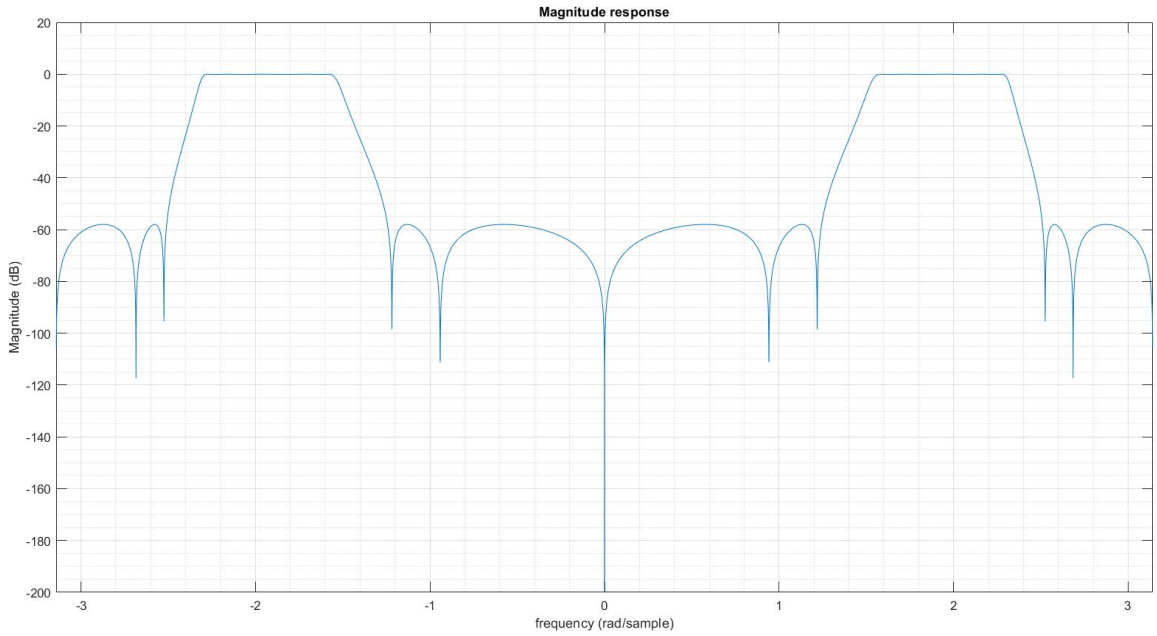
D = 3

Approximation Method : Elliptic

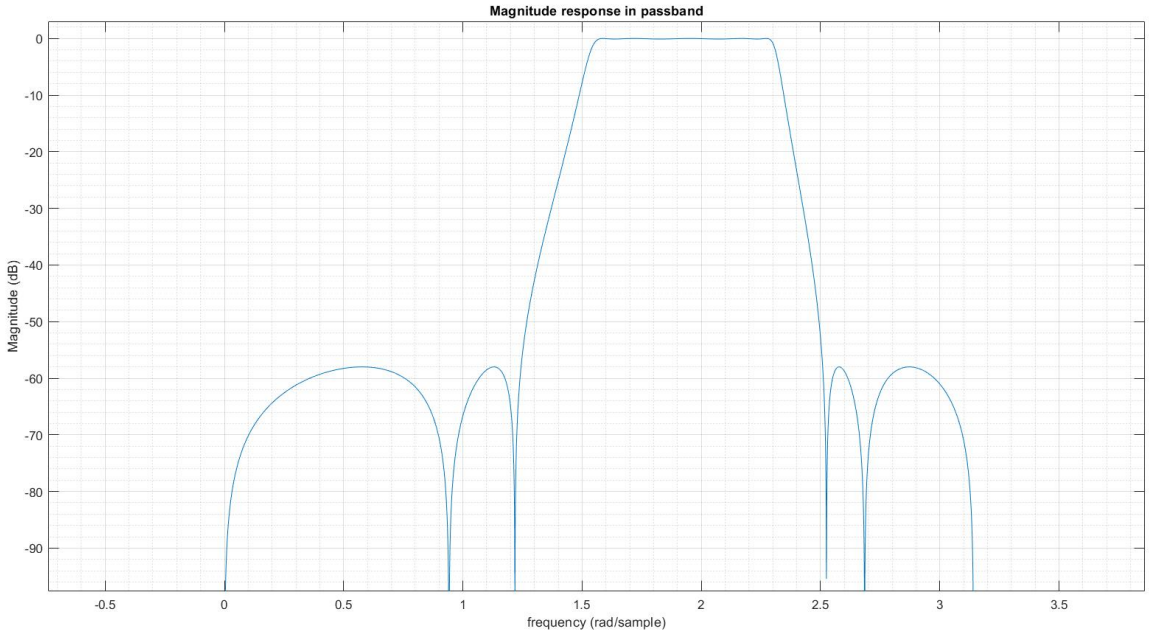
2.1 Coefficients of the Trasfer Function

k	Zeroes	Poles
0	0.007480014	1
1	0.011662351	3.070331905
2	0.002568812	7.078414662
3	0.003252407	10.79920825
4	0.012882167	13.72339129
5	-8.53E-14	13.223374
6	-0.012882167	10.79919059
7	-0.003252407	6.664838984
8	-0.002568812	3.422578911
9	-0.011662351	1.144285098
10	-0.007480014	0.293204173

2.2 Magnitude Response of the Digital Filter



2.3 Magnitude Response in the Passband

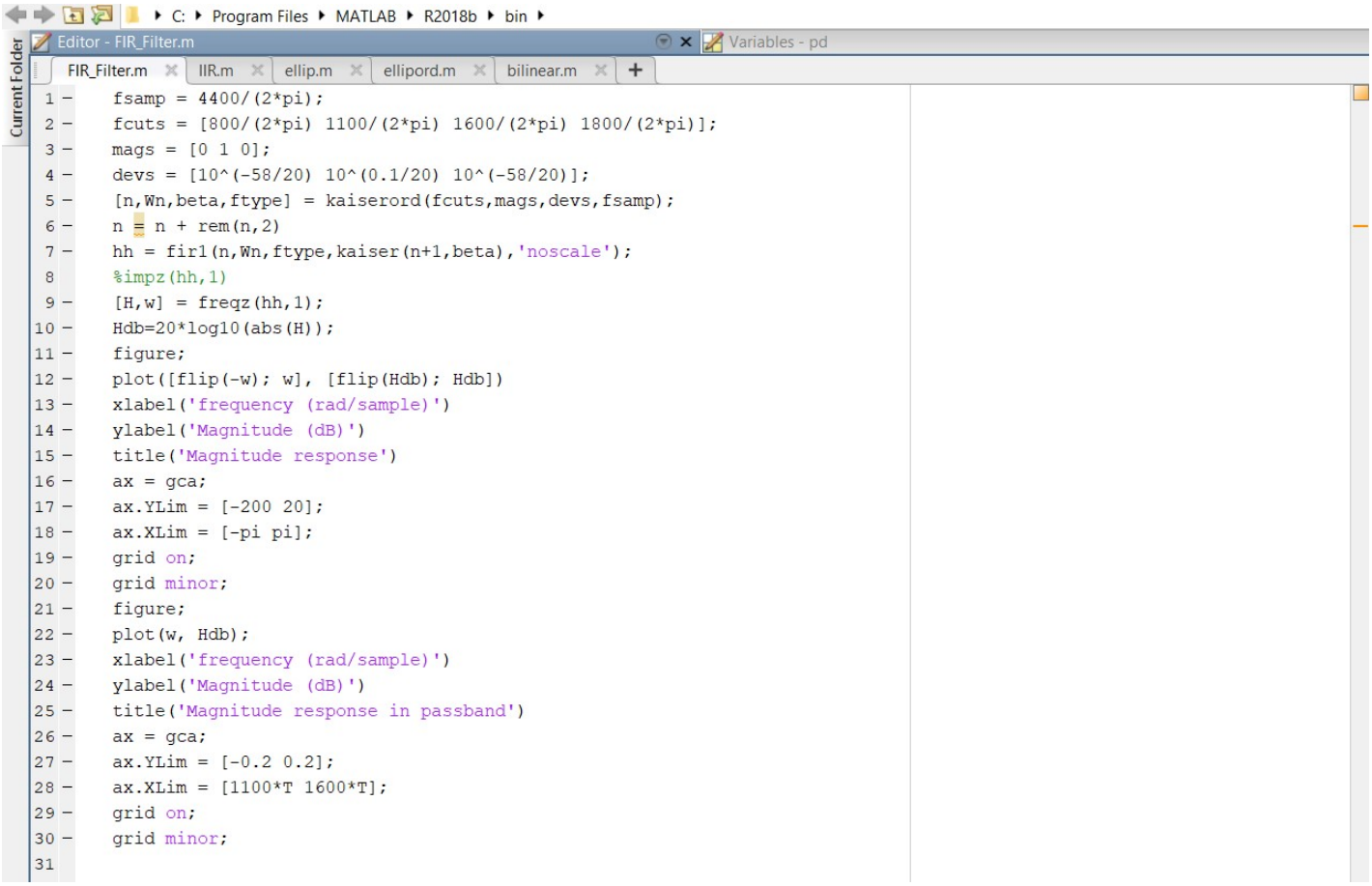


3 Comparision of FIR and IIR

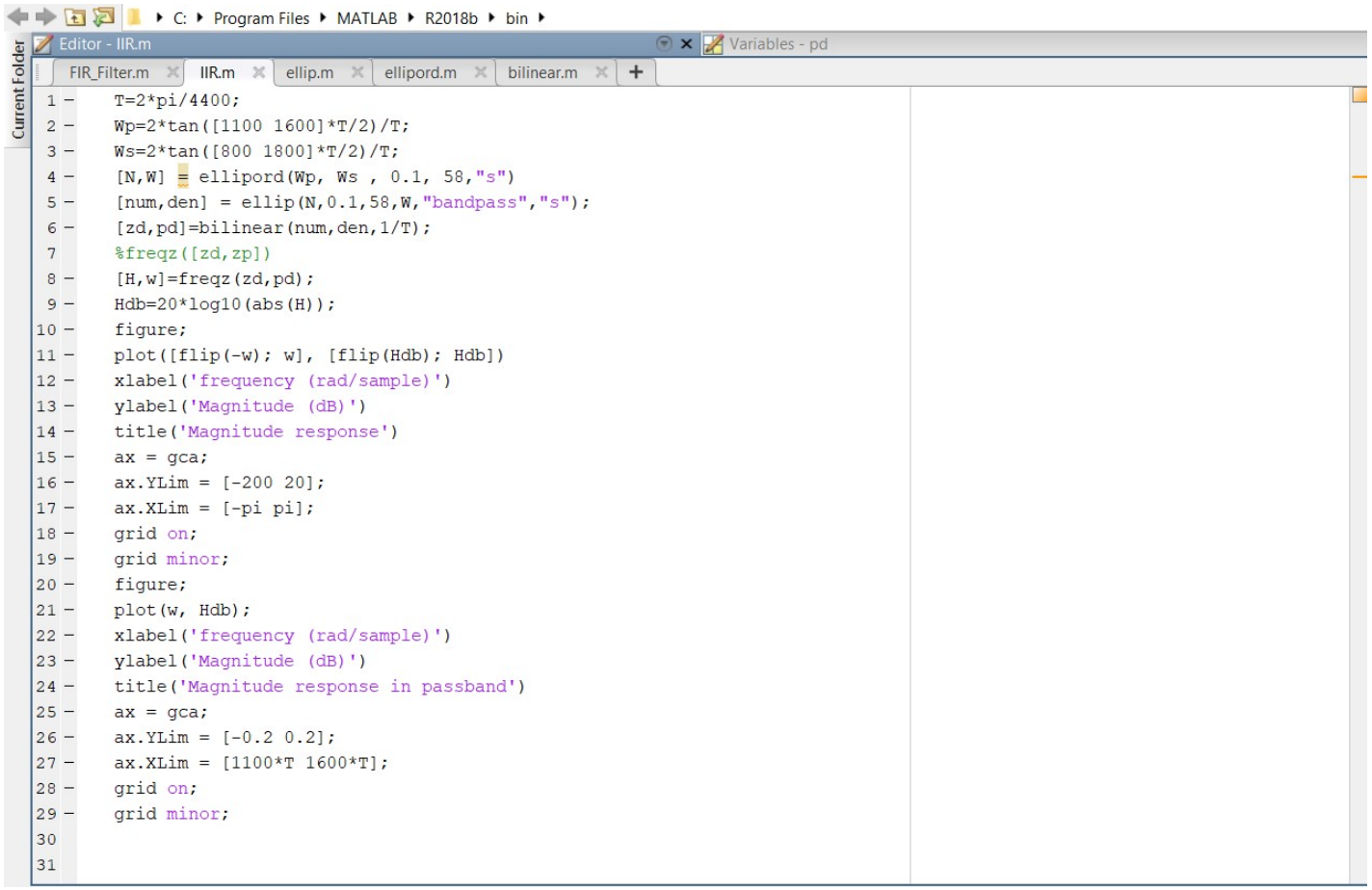
FIR Filter	IIR Filter
Order of the filter = N = 78	Order of the filter = N = 10
Number of adders required = 78	Number of adders required = 2*10 = 20
Number of multipliers required = 78+1 = 79	Number of multipliers required = 2*10+1 = 21
Group delay = 78/2 = 39	Group delay = 10/2 = 5

4 Appendices

FIR Filter.m



IIR Filter.m


C: ▸ Program Files ▸ MATLAB ▸ R2018b ▸ bin ▸
Current Folder
Editor - IIR.m
Variables - pd
FIR_Filter.m
IIR.m
ellip.m
ellipord.m
bilinear.m
1 T=2*pi/4400;
2 Wp=2*tan([1100 1600]*T/2)/T;
3 Ws=2*tan([800 1800]*T/2)/T;
4 [N,W] = ellipord(Wp, Ws , 0.1, 58,"s")
5 [num,den] = ellip(N,0.1,58,W,"bandpass","s");
6 [zd,pd]=bilinear(num,den,1/T);
7 %freqz([zd,zp])
8 [H,w]=freqz(zd,pd);
9 Hdb=20*log10(abs(H));
10 figure;
11 plot([flip(-w); w], [flip(Hdb); Hdb])
12 xlabel('frequency (rad/sample)')
13 ylabel('Magnitude (dB)')
14 title('Magnitude response')
15 ax = gca;
16 ax.YLim = [-200 20];
17 ax.XLim = [-pi pi];
18 grid on;
19 grid minor;
20 figure;
21 plot(w, Hdb);
22 xlabel('frequency (rad/sample)')
23 ylabel('Magnitude (dB)')
24 title('Magnitude response in passband')
25 ax = gca;
26 ax.YLim = [-0.2 0.2];
27 ax.XLim = [1100*T 1600*T];
28 grid on;
29 grid minor;
30
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