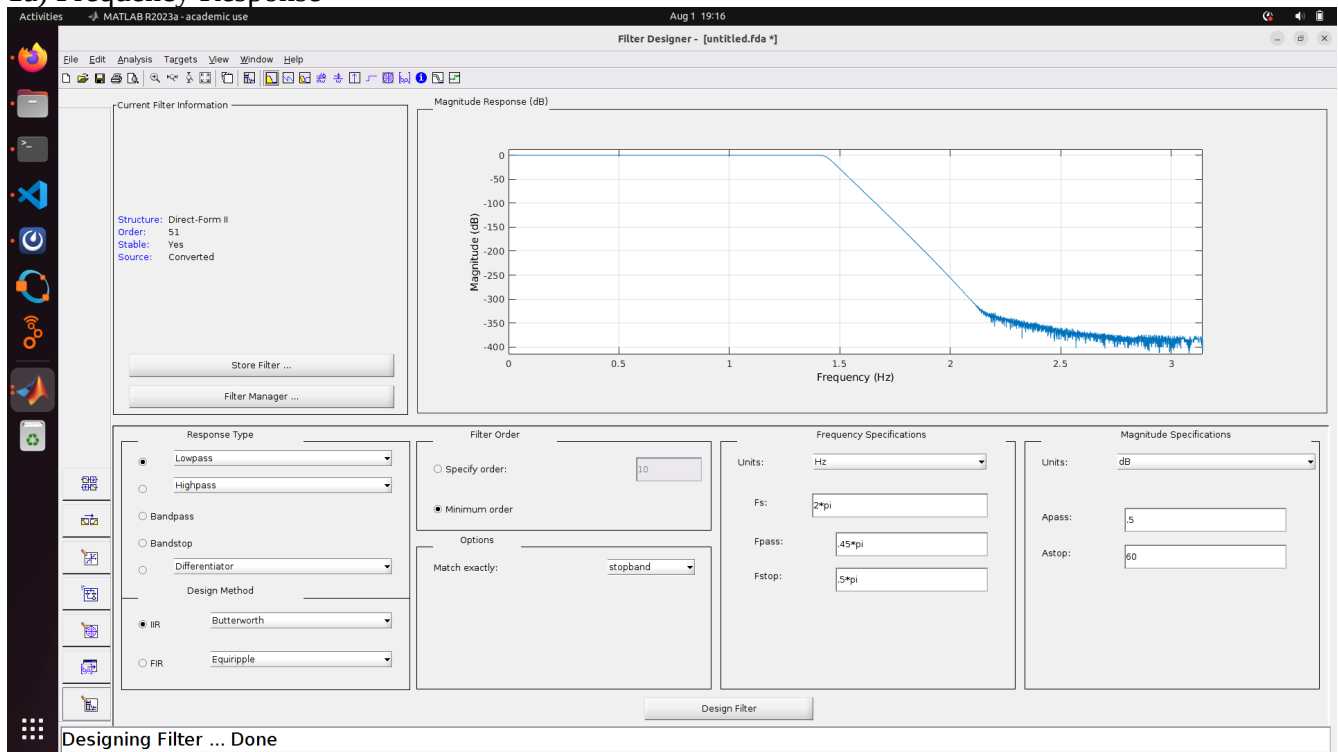
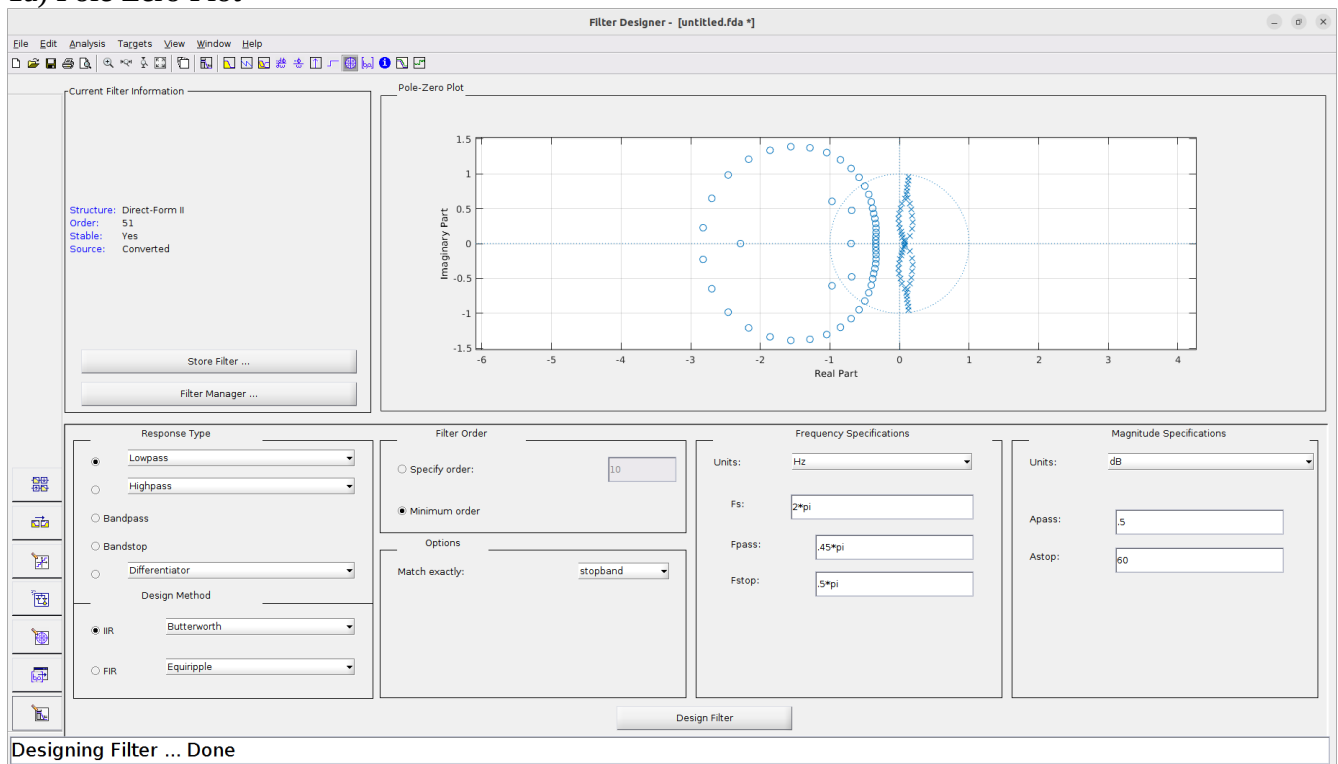


HW9

1a) Frequency Response



1a) Pole Zero Plot



1a) Coefficients

A)

1

-4.38354402101529
16.2748775393327
-41.8403663588703
93.7912232426107
-174.989163736413
292.334707955330
-431.248194548530
579.722637064334
-707.089513154840
795.122227136974
-823.403591449256
792.371034257115
-708.556178802205
591.989315020949
-462.249083991011
338.486350274588
-232.507342052900
150.139104289026
-91.1551620553554
52.1026417662570
-28.0358014668440
14.2111808774175
-6.78415461824185
3.05057724276259
-1.29140517661688
0.514541172360040
-0.192798557307813
0.0678914787002092
-0.0224419168495347
0.00695586061758425
-0.00201846823370359
0.000547486345998350
-0.000138524234325554
3.26228604560259e-05
-7.13191959861140e-06
1.44307788688431e-06
-2.69302715108016e-07
4.61652692453798e-08
-7.23510367756377e-09
1.03091002339916e-09
-1.32664741739260e-10
1.52966507080209e-11
-1.56496572922098e-12
1.40353181618839e-13
-1.08648778136344e-14
7.11346413699079e-16
-3.83056514367495e-17
1.62912143610840e-18

-5.13123598915643e-20
1.06418837087416e-21
-1.09017084901164e-23

B)

3.30177683885160e-15
1.68390618781432e-13
4.20976546953579e-12
6.87595026690845e-11
8.25114032029015e-10
7.75607190107274e-09
5.94632179082243e-08
3.82263543695728e-07
2.10244949032650e-06
1.00450364537822e-05
4.21891531058852e-05
0.000157250479758299
0.000524168265860997
0.00157250479758299
0.00426822730772527
0.0105282940257223
0.0236886615578752
0.0487707737956255
0.0921225727250703
0.160002363154069
0.256003781046511
0.377910343449612
0.515332286522198
0.649766796049728
0.758061262058016
0.818706163022657
0.818706163022657
0.758061262058016
0.649766796049728
0.515332286522198
0.377910343449612
0.256003781046511
0.160002363154069
0.0921225727250703
0.0487707737956255
0.0236886615578752
0.0105282940257223
0.00426822730772527
0.00157250479758299
0.000524168265860998
0.000157250479758299
4.21891531058852e-05
1.00450364537822e-05
2.10244949032650e-06

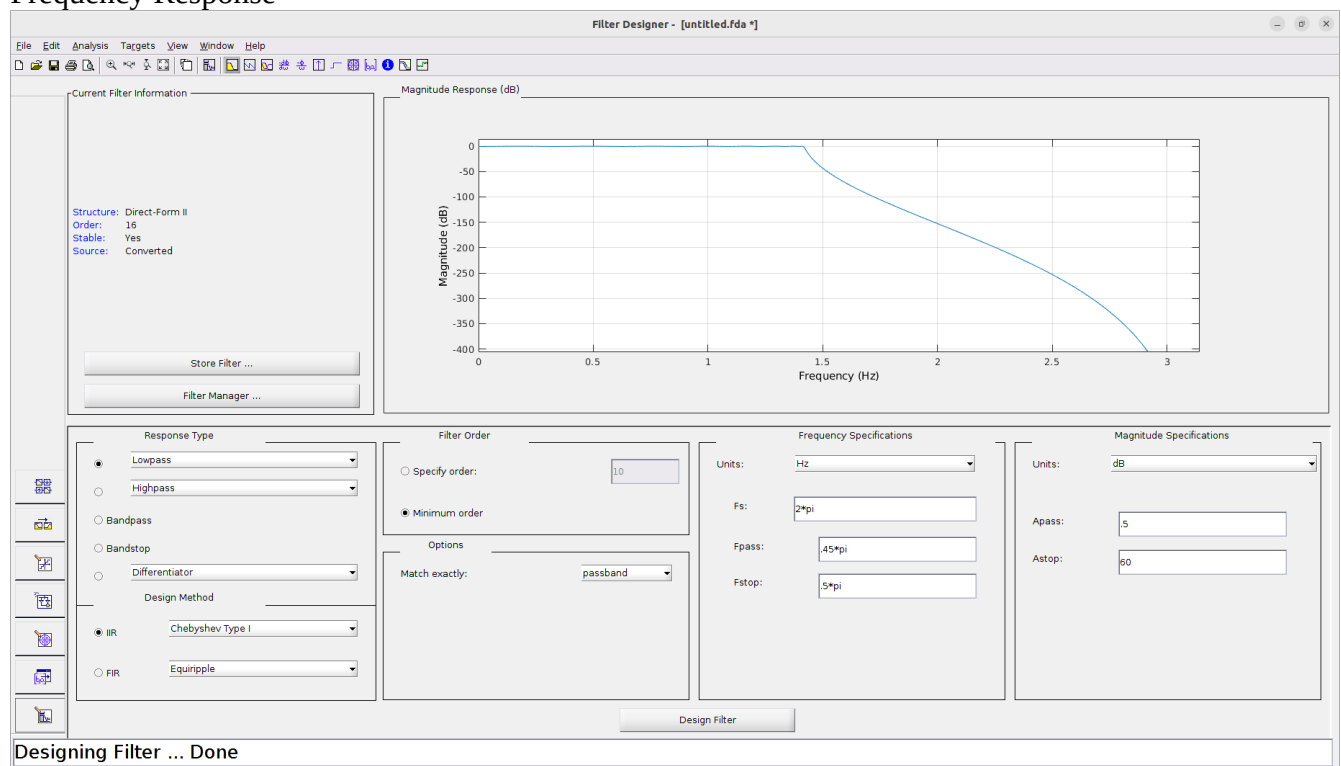
3.82263543695728e-07
 5.94632179082243e-08
 7.75607190107274e-09
 8.25114032029015e-10
 6.87595026690846e-11
 4.20976546953579e-12
 1.68390618781432e-13
 3.30177683885160e-15

N = 52

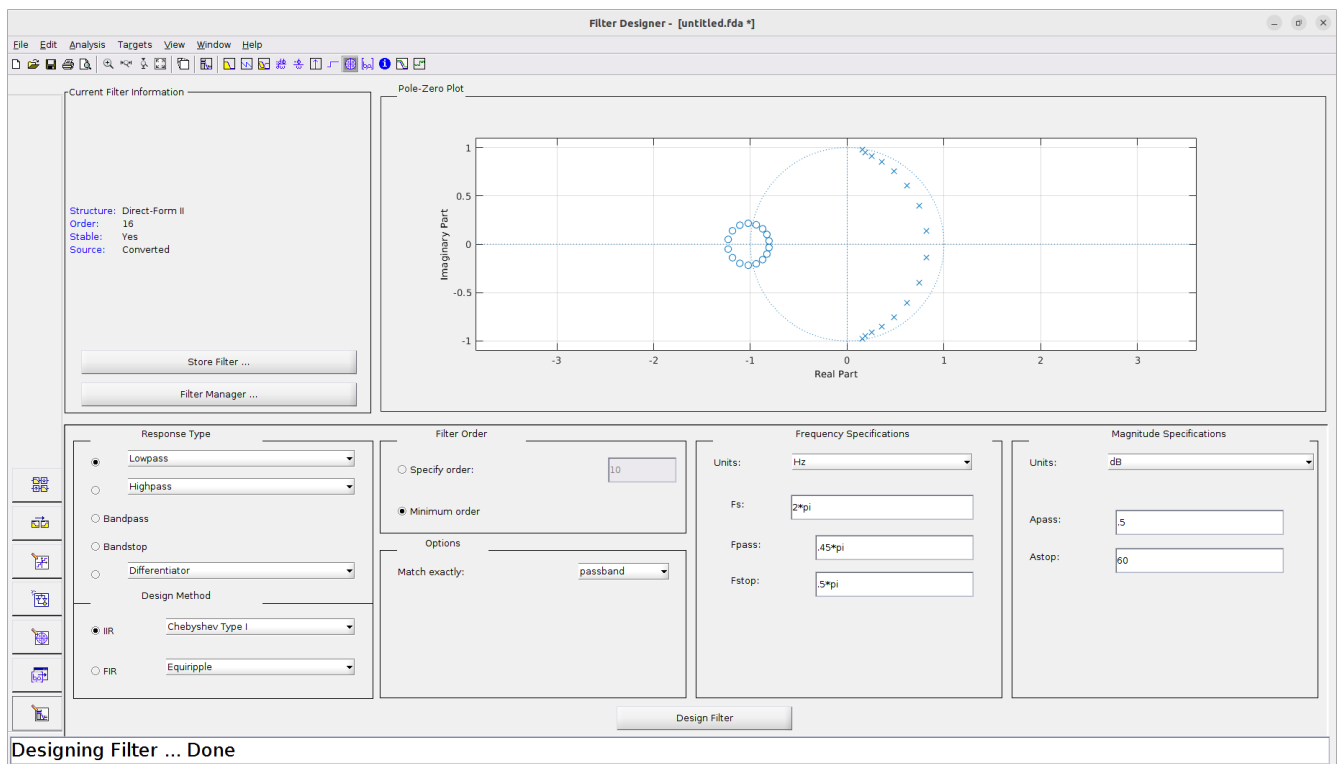
Max atten = about -490dB

1b)

Frequency Response



Pole Zero



Coefficients)

a =

1

-7.21683113670212
 28.4751912229379
 -78.2983795097531
 165.091515606246
 -280.055702092561
 392.735696694519
 -462.398457370582
 460.680221921233
 -389.117684840792
 277.655578122458
 -165.757720263415
 81.3380306472637
 -31.8342941245831
 9.42836256384595
 -1.90624657919808
 0.201737346291808

b =

3.02772020186600e-07
 4.84435232298560e-06
 3.63326424223920e-05
 0.000169552331304496
 0.000551045076739612

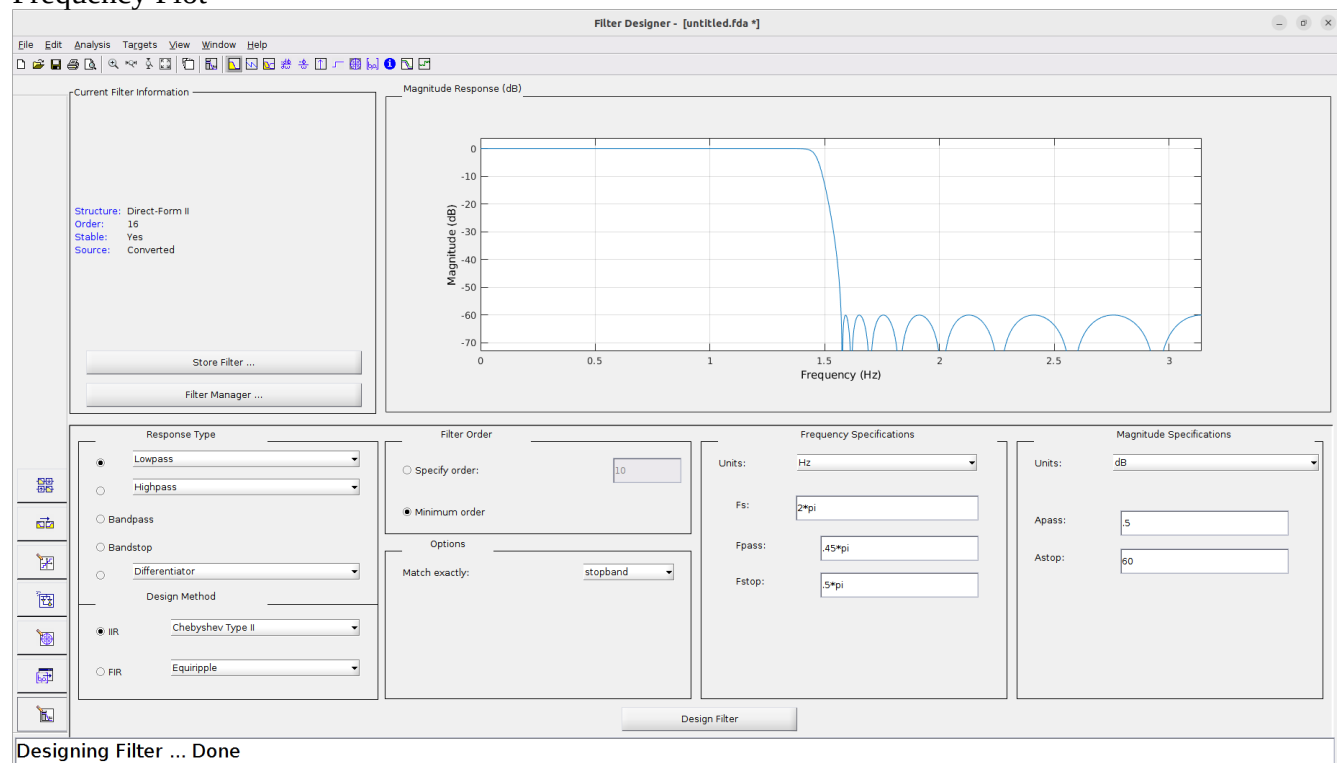
0.00132250818417507
 0.00242459833765429
 0.00346371191093470
 0.00389667589980154
 0.00346371191093470
 0.00242459833765429
 0.00132250818417507
 0.000551045076739612
 0.000169552331304496
 3.63326424223920e-05
 4.84435232298560e-06
 3.02772020186600e-07

$N = 16$

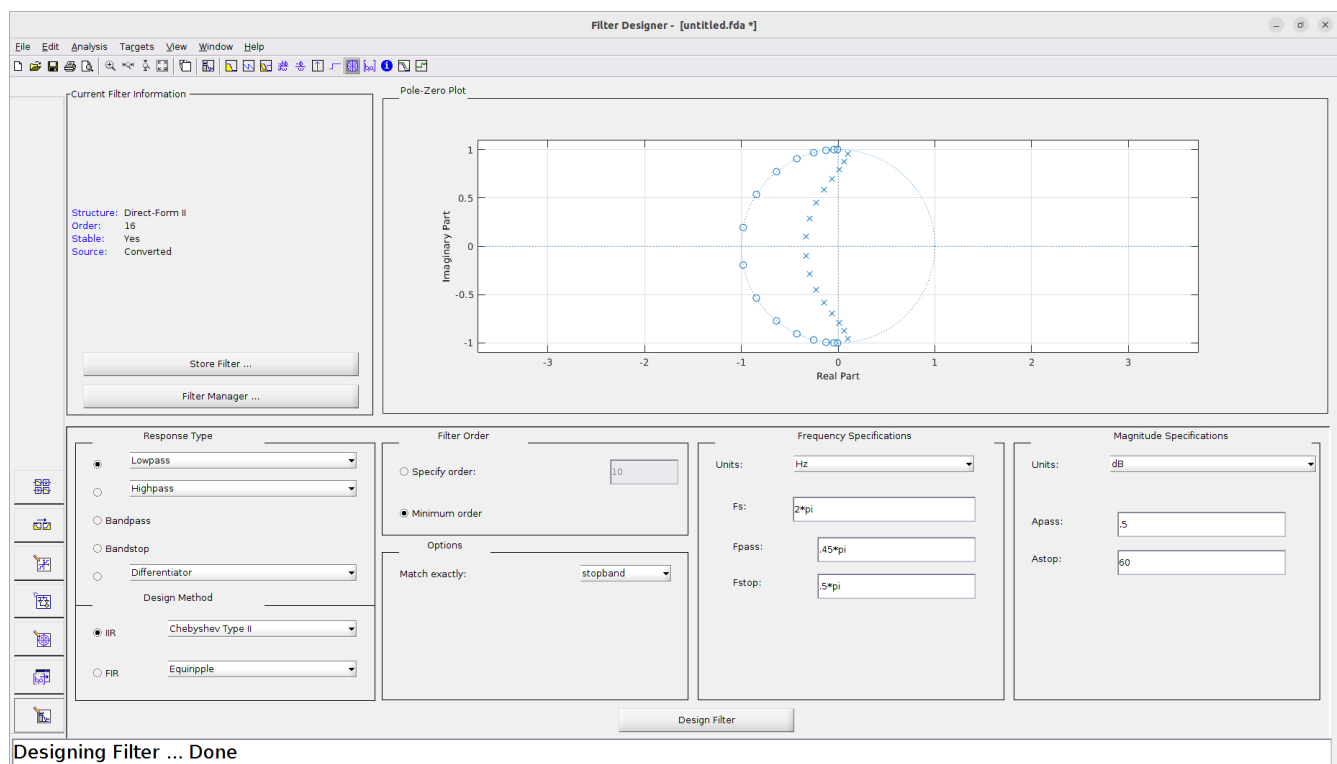
Max atten = > 400dB

1c)

Frequency Plot



Pole Zero



Coefficients)

a =

1

1.79516200311509
 4.74070862936952
 6.61306880926972
 9.43793601946769
 10.1583240267863
 10.0521282897678
 8.33194722562959
 6.12046270063151
 3.86358728525964
 2.11265838892548
 0.981370779824759
 0.381016488086449
 0.119559888045919
 0.0287375089803150
 0.00476162604834957
 0.000415515248895133

b =

0.0203841681634016
 0.135094382575077
 0.515210595001715
 1.40477203595967
 2.99897692939222
 5.24308025402115

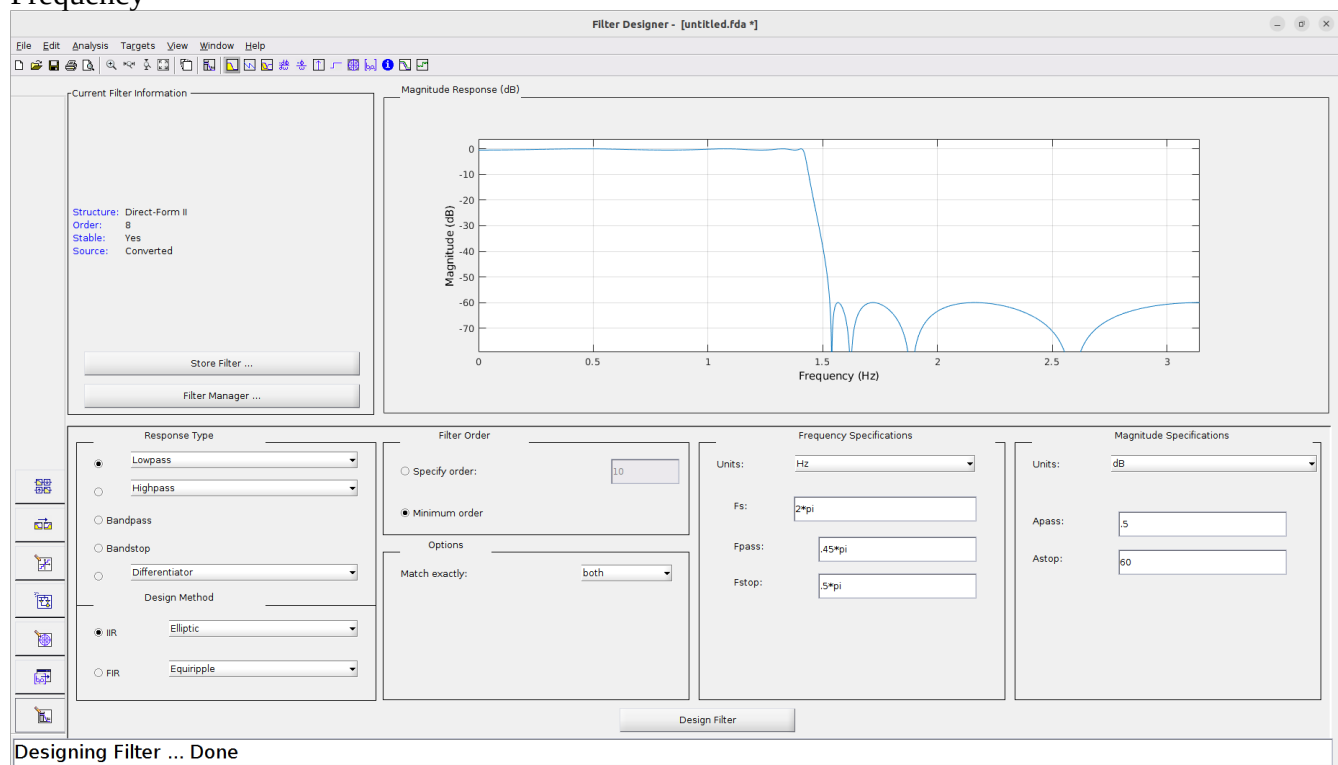
7.70276887903282
 9.65201305308425
 10.3972445899965
 9.65201305308425
 7.70276887903282
 5.24308025402115
 2.99897692939221
 1.40477203595967
 0.515210595001714
 0.135094382575077
 0.0203841681634016

$N = 16$

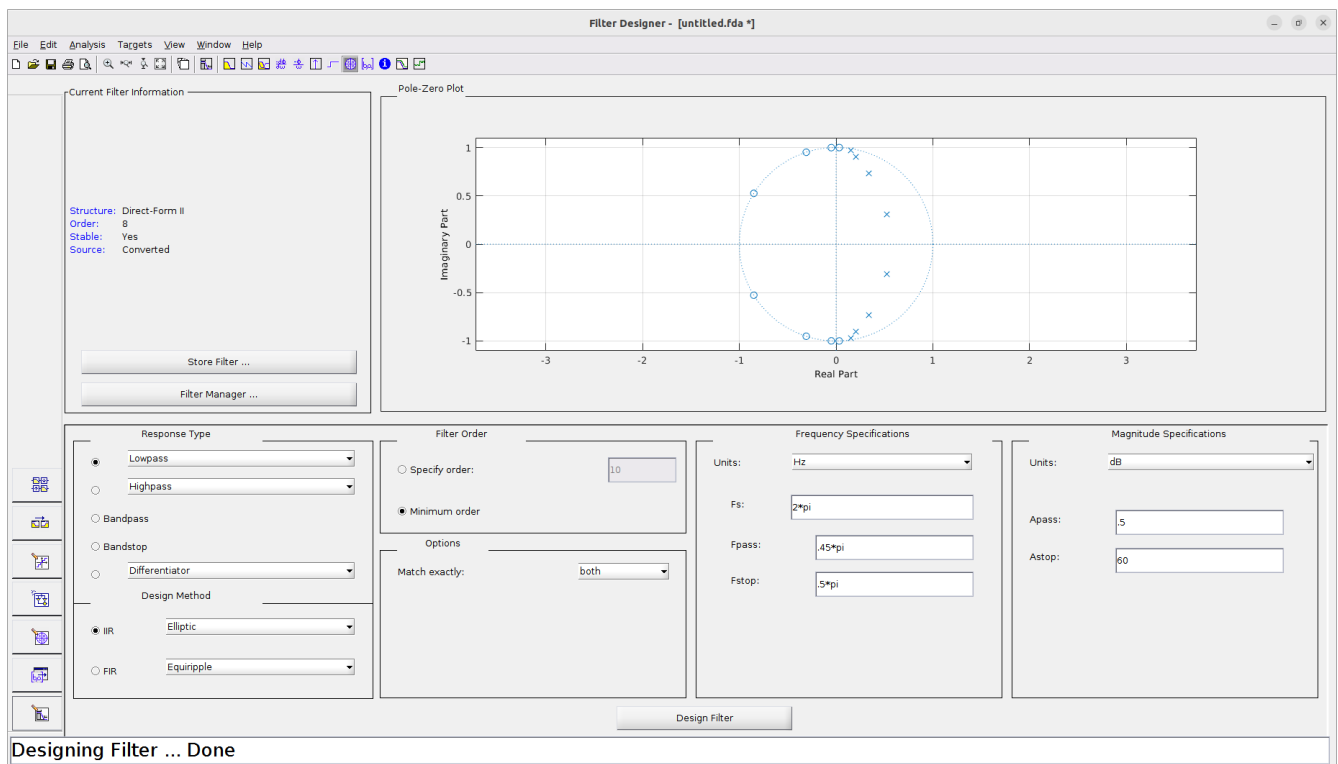
Max atten = $\sim 125\text{dB}$

1d)

Frequency



Pole Zero



Coefficients

a =

1

-2.44439331708647

4.91930535394772

-6.20736963487370

6.26349501563445

-4.58002587693542

2.53193851753678

-0.938819790166164

0.201569158298131

b =

0.0178858975695283

0.0420827878486086

0.0916641973137829

0.126641896456999

0.147436095513069

0.126641896456999

0.0916641973137829

0.0420827878486086

0.0178858975695283

N = 8

Max atten = ~125dB