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Lab 2 ( Edisp)

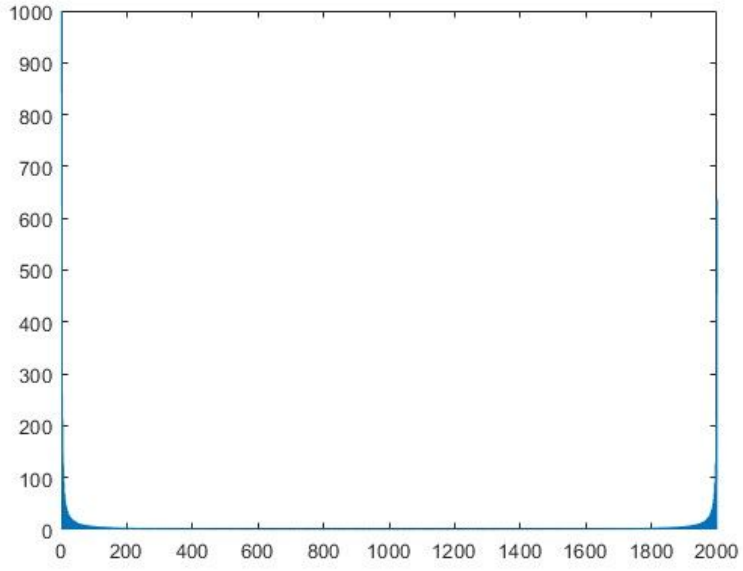
Task 1:

| case | $F_s$ | T[ms] | N | $N_1$ | $A_{max}$ | $K_{null}$ | $F_n$ at null | F at null |
|---|---|---|---|---|---|---|---|---|
| $x_1[n]$ | 1000 MHz | 2 | 2 | 2000 | 1000 | 1000 | 3 | 0.001 |
| $x_2[n]$ | 10kHz | 2 | 2 | 20 | 10 | 10 | 3 | 0.1 |
| $x_3[n]$ | 10KHz | 4 | 4 | 40 | 20 | 20 | 3 | 0.05 |

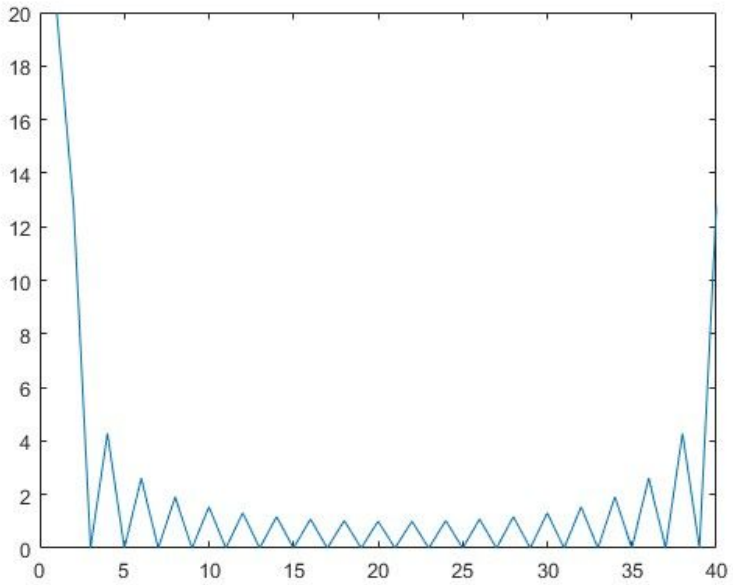
Here,

$N=T*F_s$; $N_1=N/2$; $F_n$=k/signal length; $F_1=F_n*1e^6$;
$F_{2,3}=F_n*1e^4$;

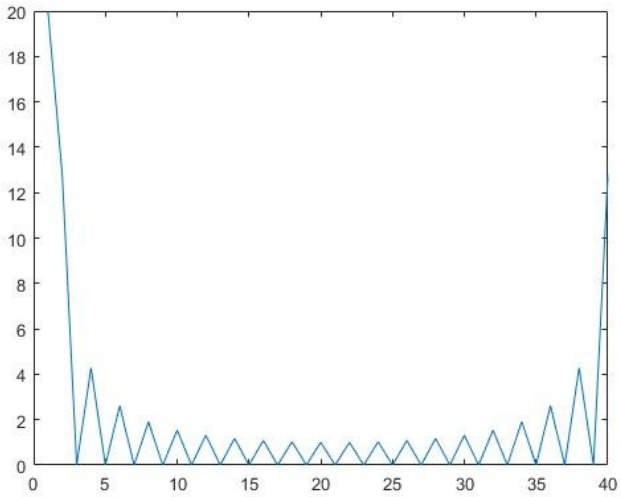
Case #1 (Fs = 1 MHz, T = 2 ms)



Case #2 (Fs = 10 kHz, T = 2 ms)




Case #3 (Fs = 10 kHz, T = 2 ms)

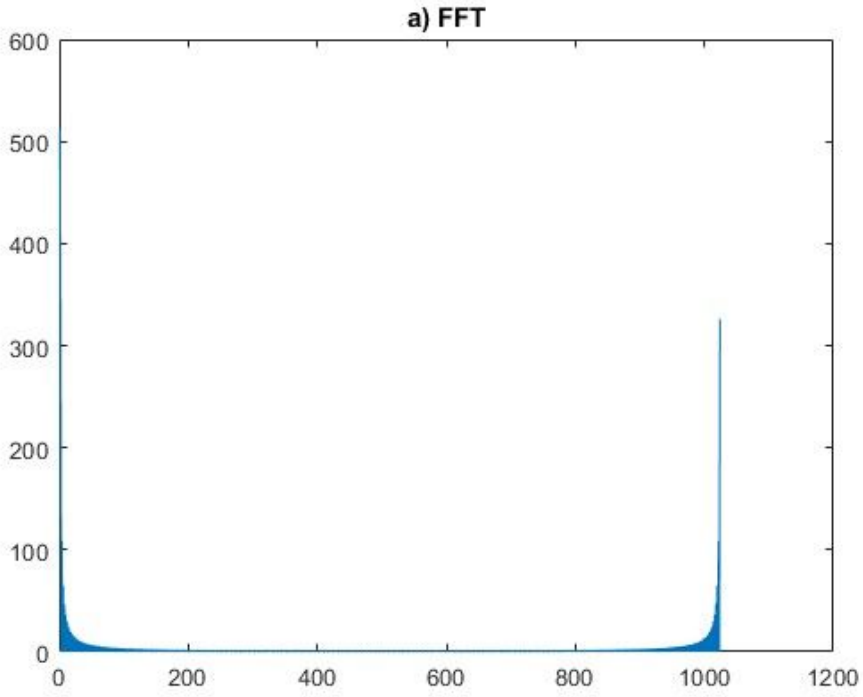



The greater sample frequecy and higher density spectrum of the signal is due to greater number of samples N.

In case 2 and case 3 we have highest amplitude and in the case of the 3rd frequency it had a greater period at T = 4ms. And in the case 2 the physical frequcny were lower although the samples were more in case 2.

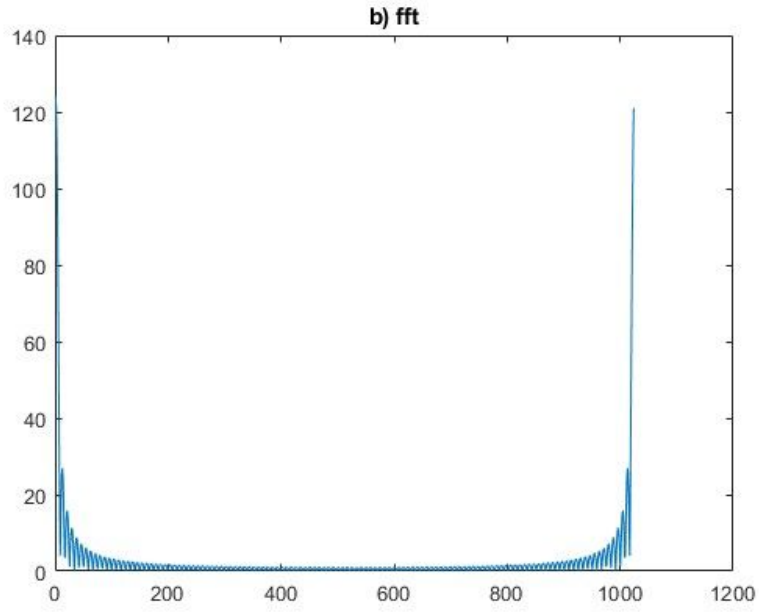
Task 2-

Signal a) 512 points square impulse

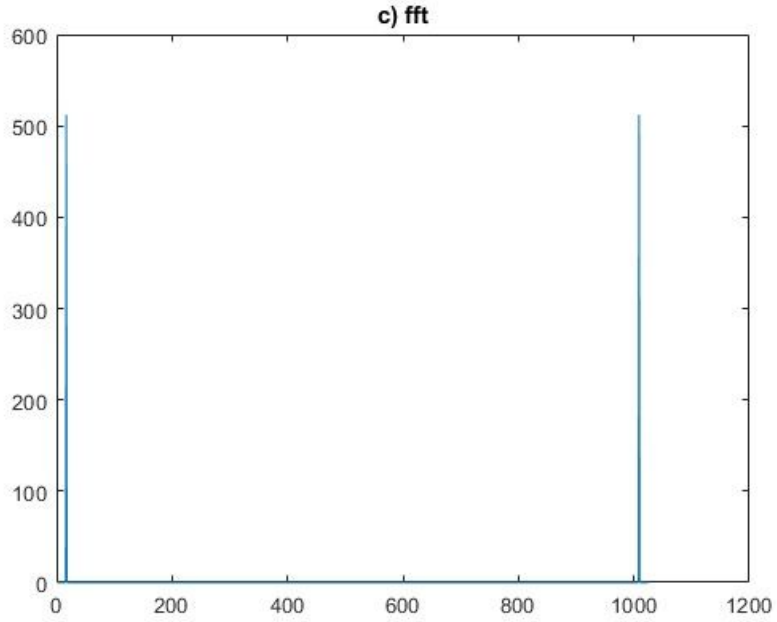



Signal b)

Number of zero crossings = 255

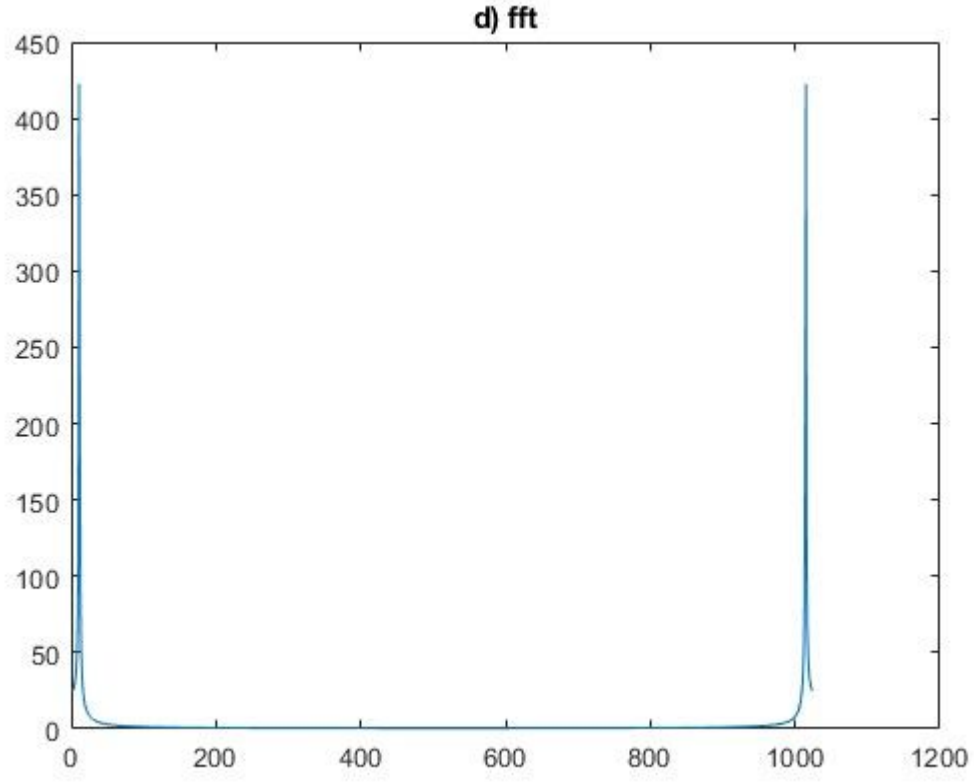


Signal c)

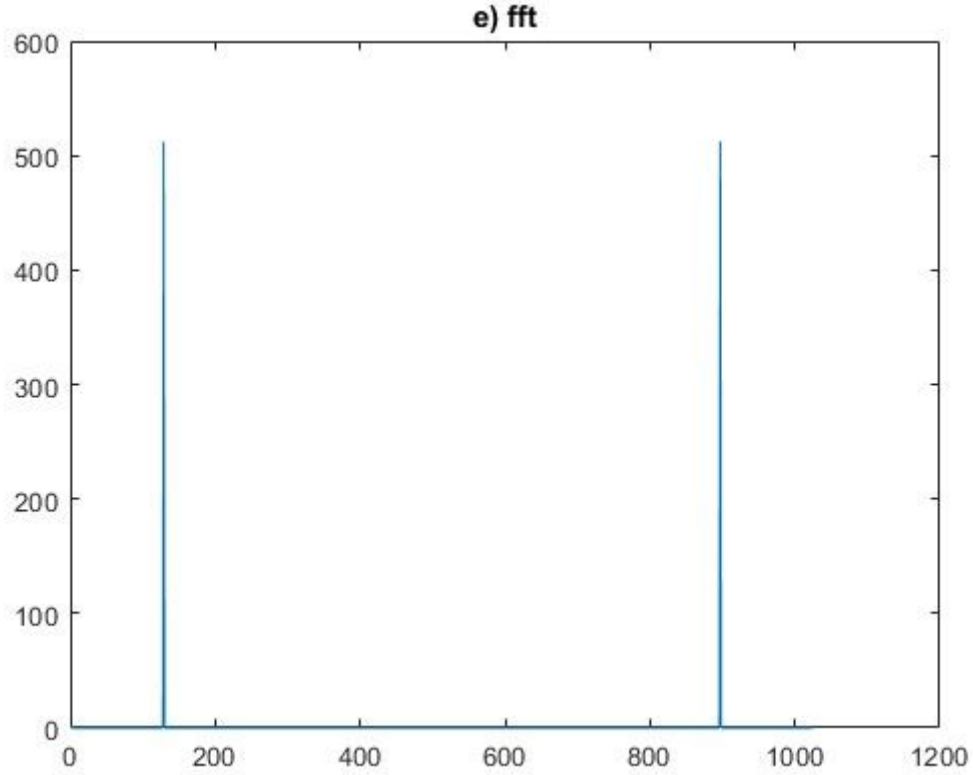



Signal d)

Sine wave with non-integer number of periods

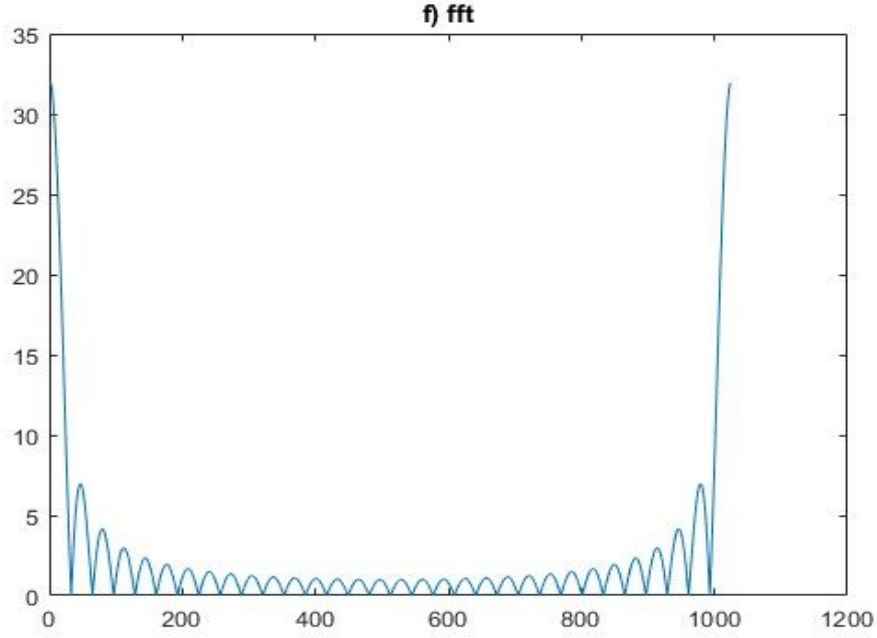


Signal e)



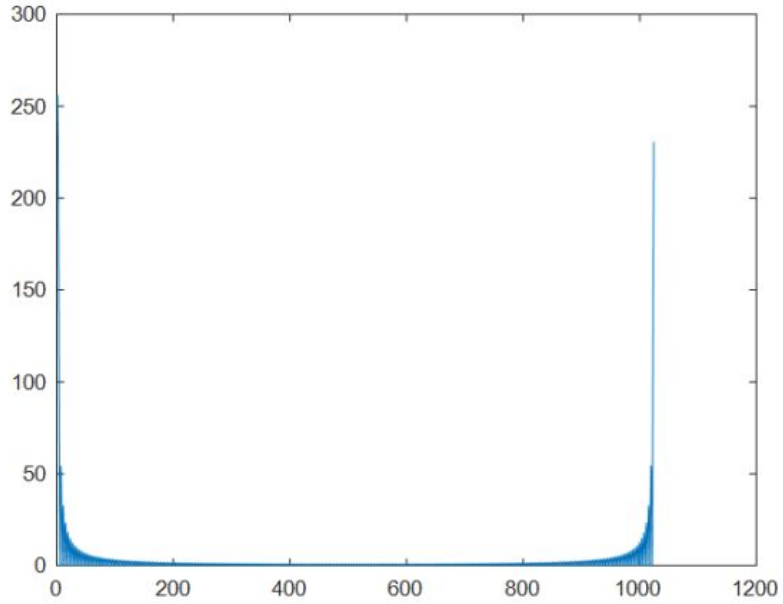

Signal f)

f) A 32-point square impulse beginning at n =0

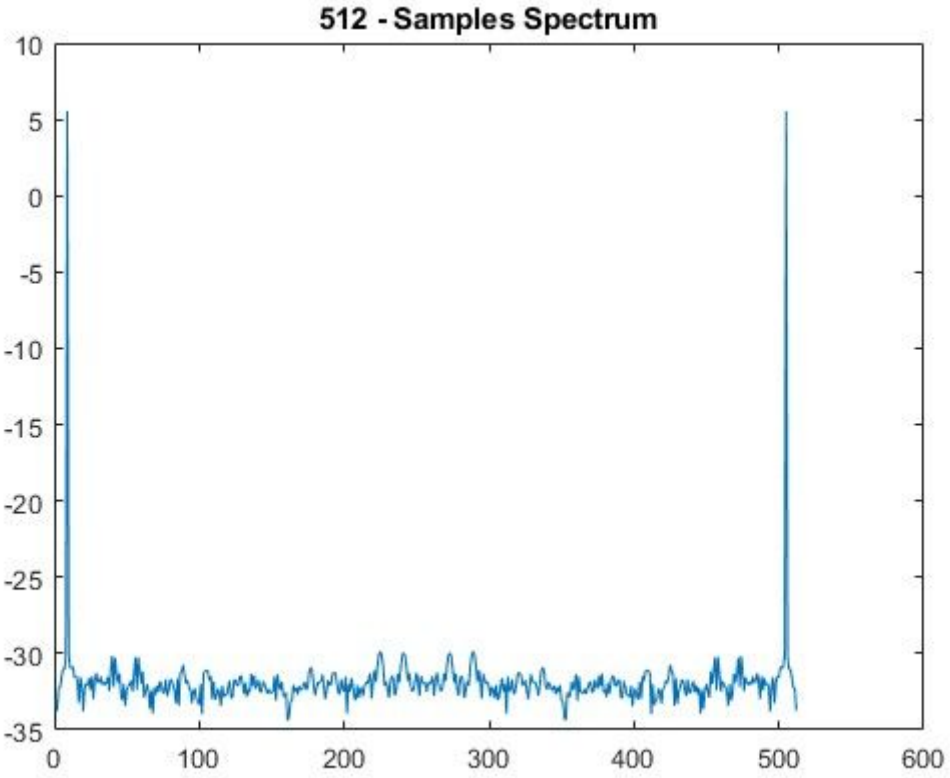


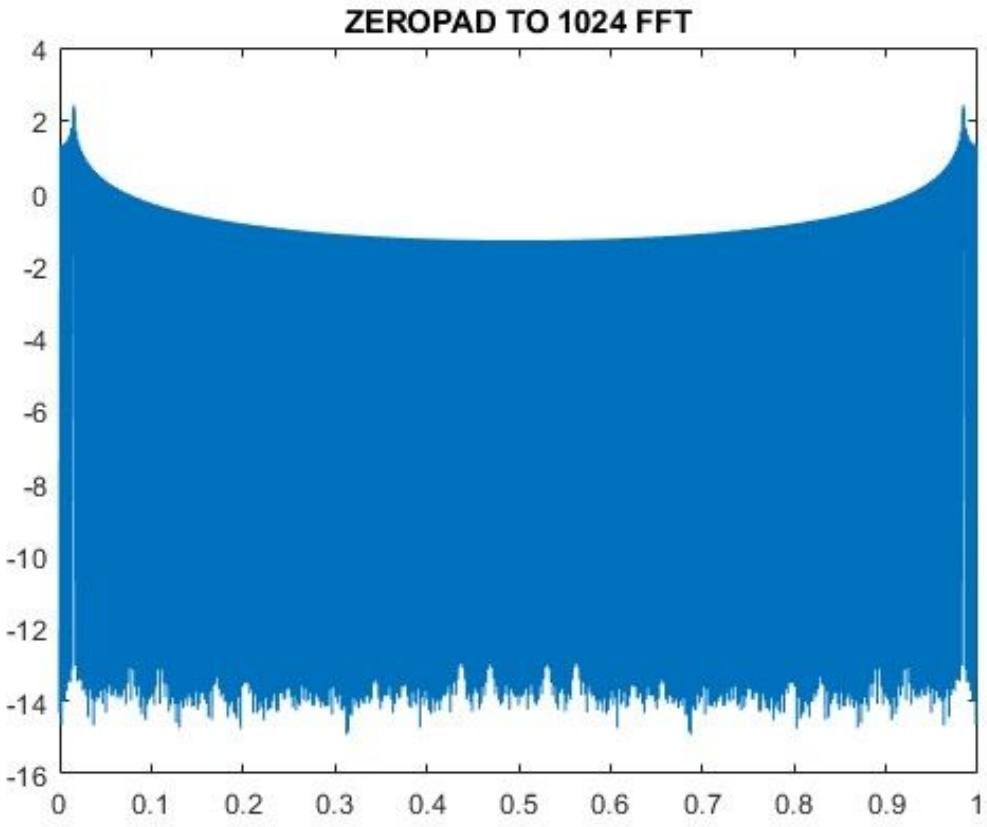
Signal g)

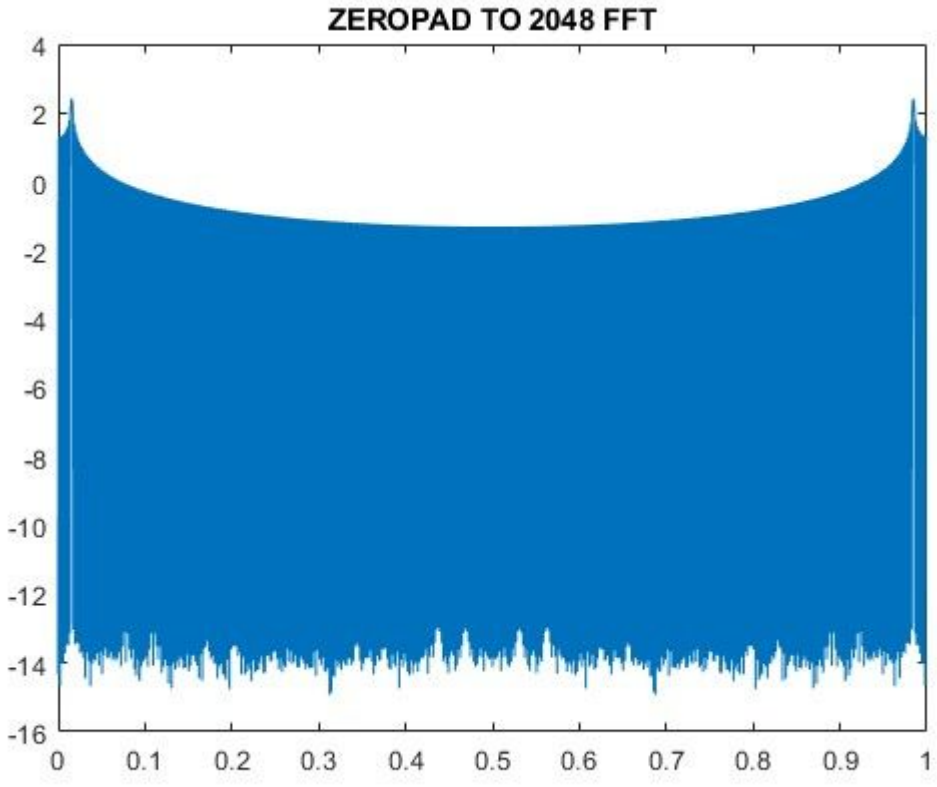
g) A 32-point square impusle beginning at n = Ns > 0

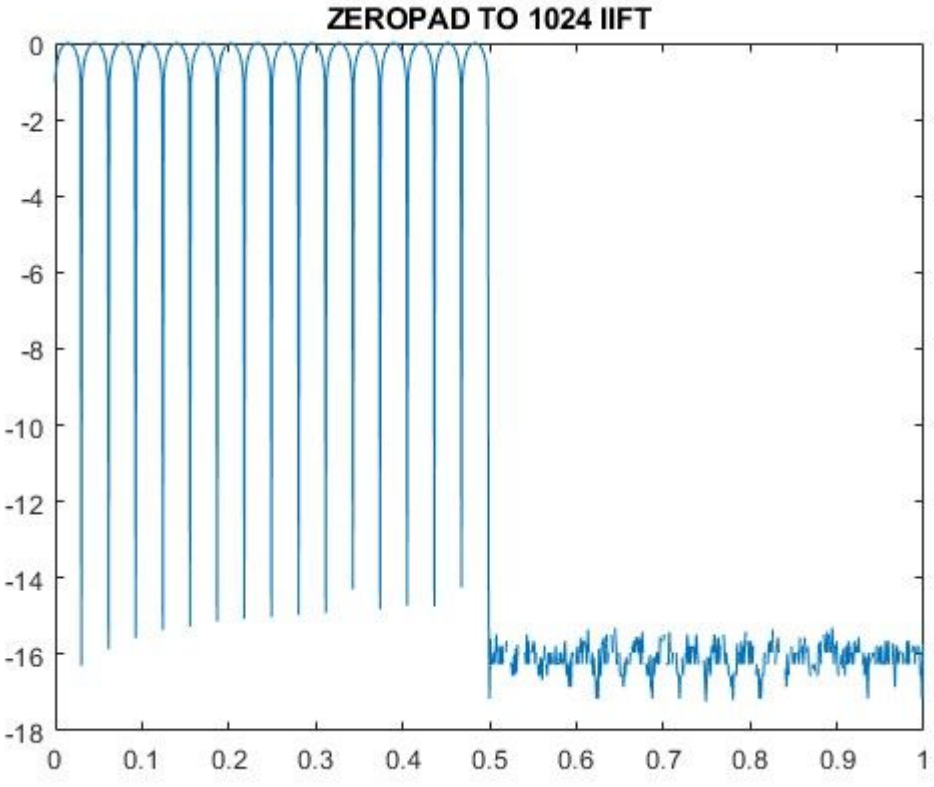


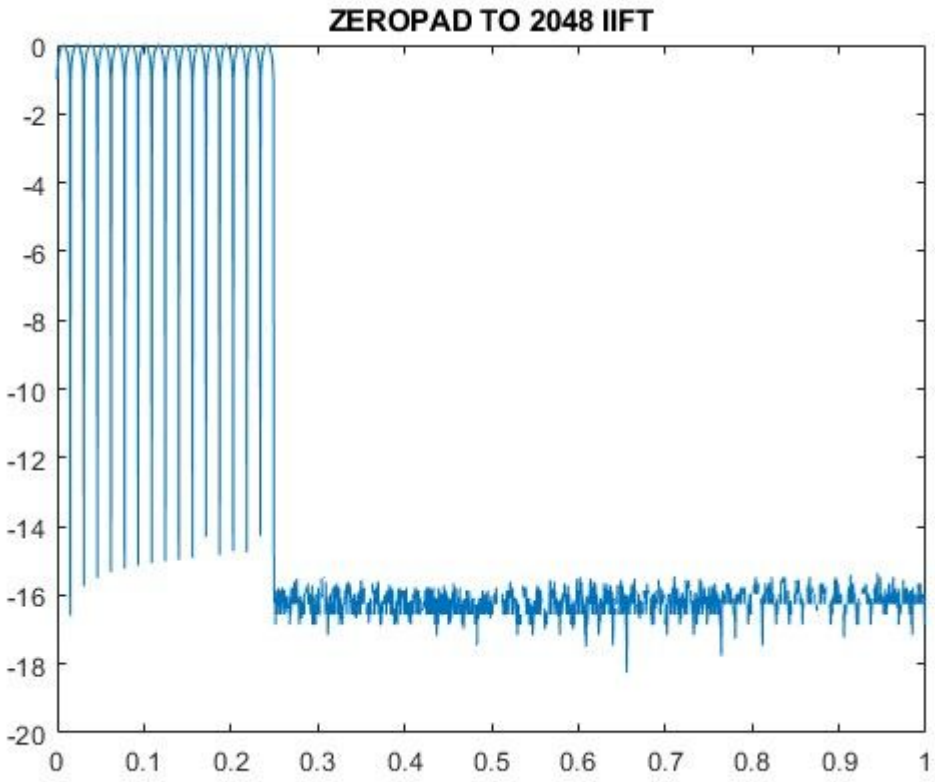

Task 3


512 - Samples Spectrum
10
5
0
-5
-10
-15
-20
-25
-30
-35
0
100
200
300
400
500
600


ZEROPAD TO 1024 FFT
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


ZEROPAD TO 2048 FFT
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

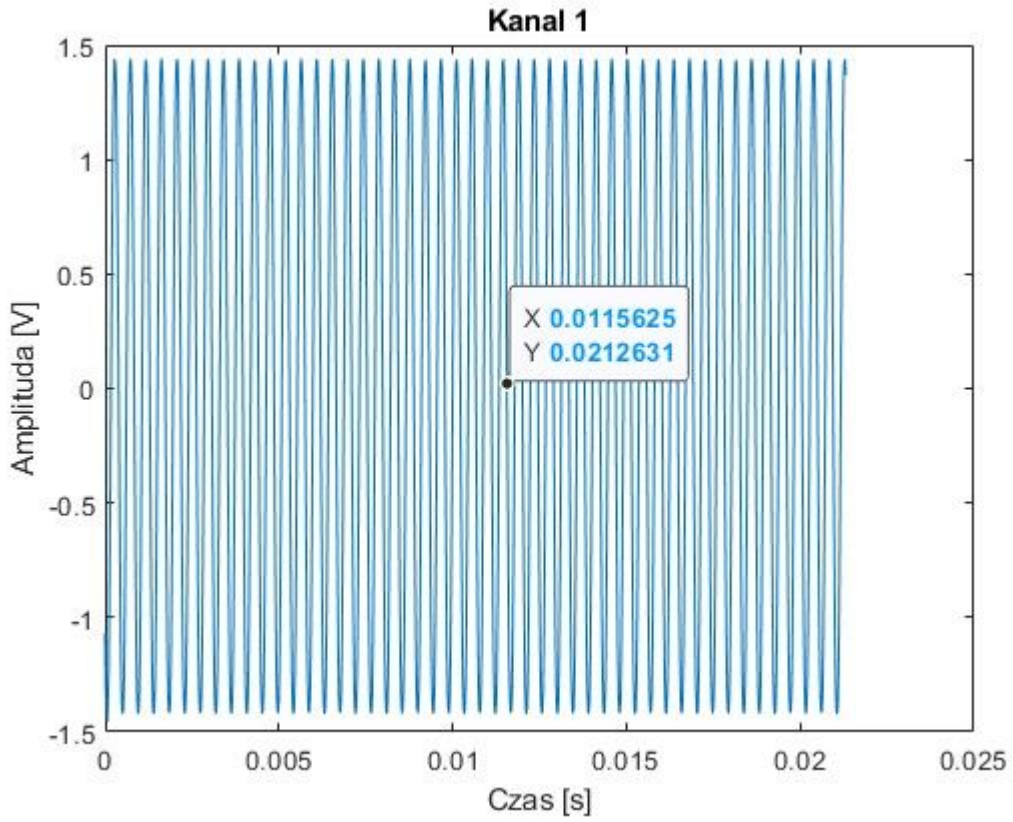

ZEROPAD TO 1024 IIFT
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

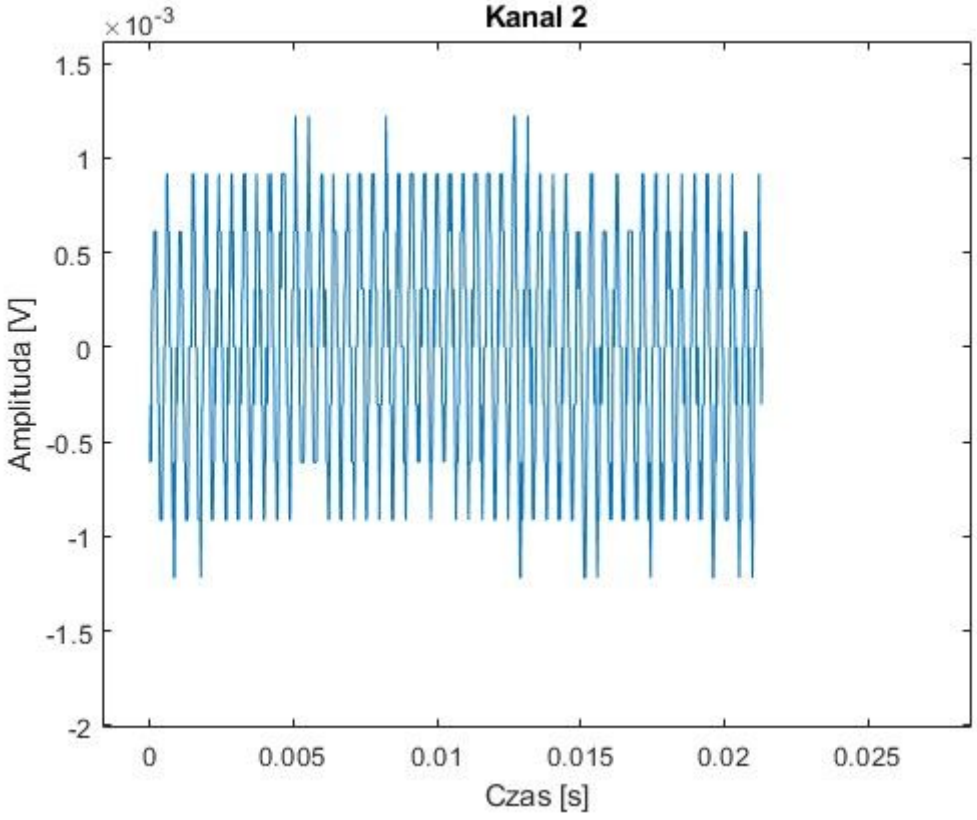



Through the application of FFT a fluctuating point is produced with two peaks on the ends.

And due to application IFFT to the those signals, we obtained signals with repeating peaks.

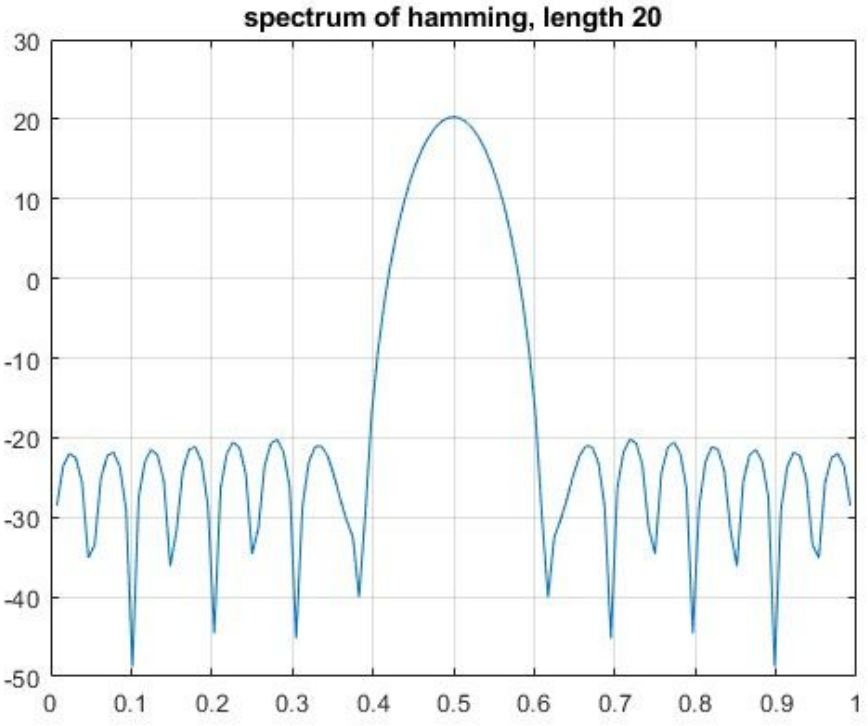
Task 5
N = 1024, $F_s$ = 48kHz, Fn = 1/64 Hz

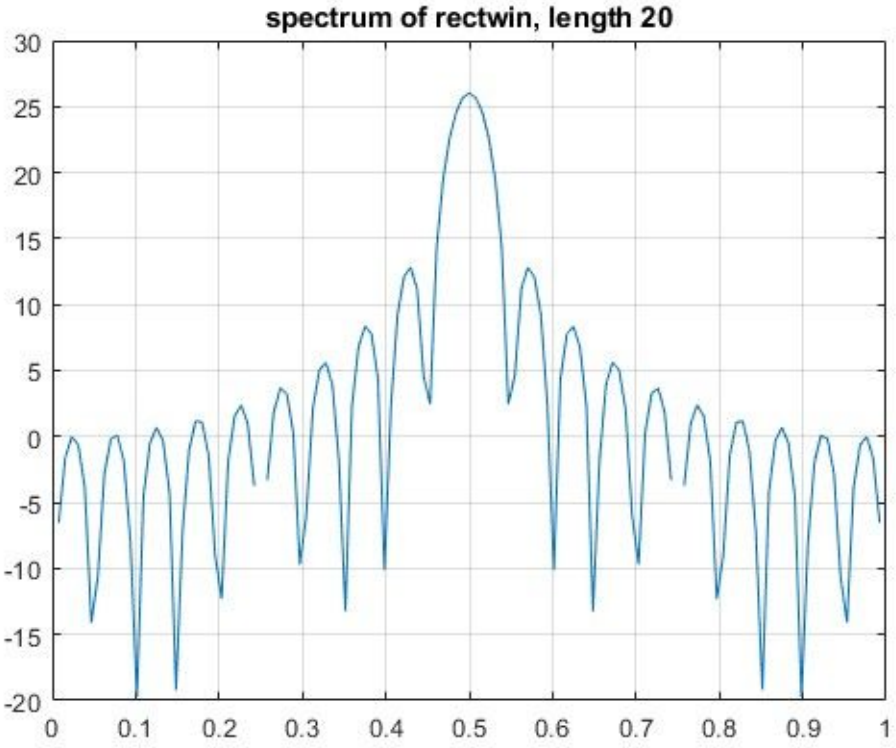



Kanal 2
×10^-3
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Amplituda [V]
0
0.005
0.01
0.015
0.02
0.025
Czas [s]

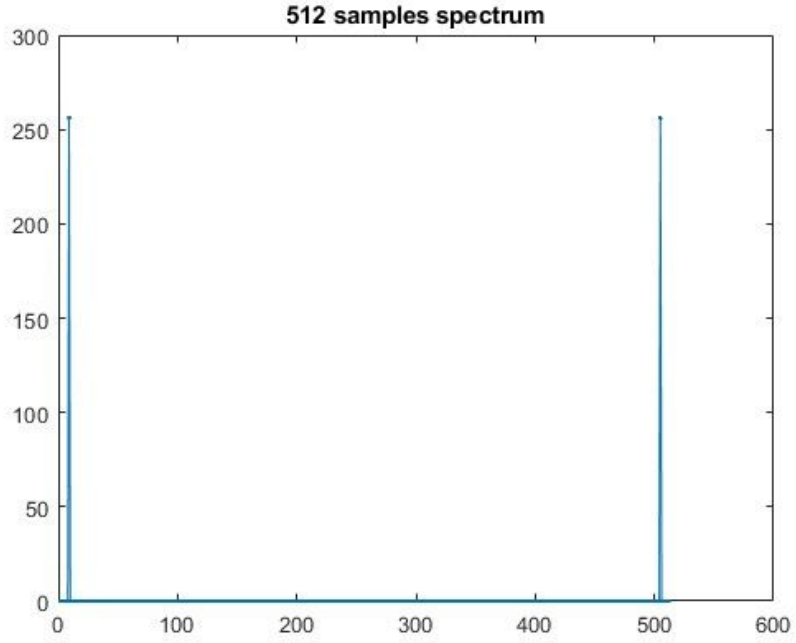
Task 6-

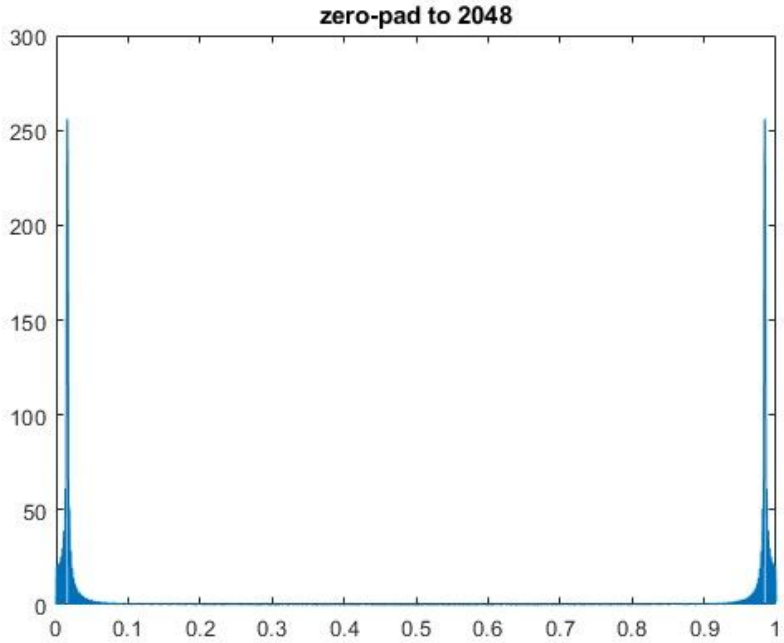
| Window type | Mainlobe width | First sidelobe | Highest sidelobe | Sidelobes change with f |
|---|---|---|---|---|
| | Normalized freq. | dB below mainl. | dB below mainl. | describe shortly |
| rectangular | 0.1 | 0.6 | 0.6 | Decreases with higher f |
| hamming | 0.24 | 0.66 | 0.71 | Decreases with higher f |

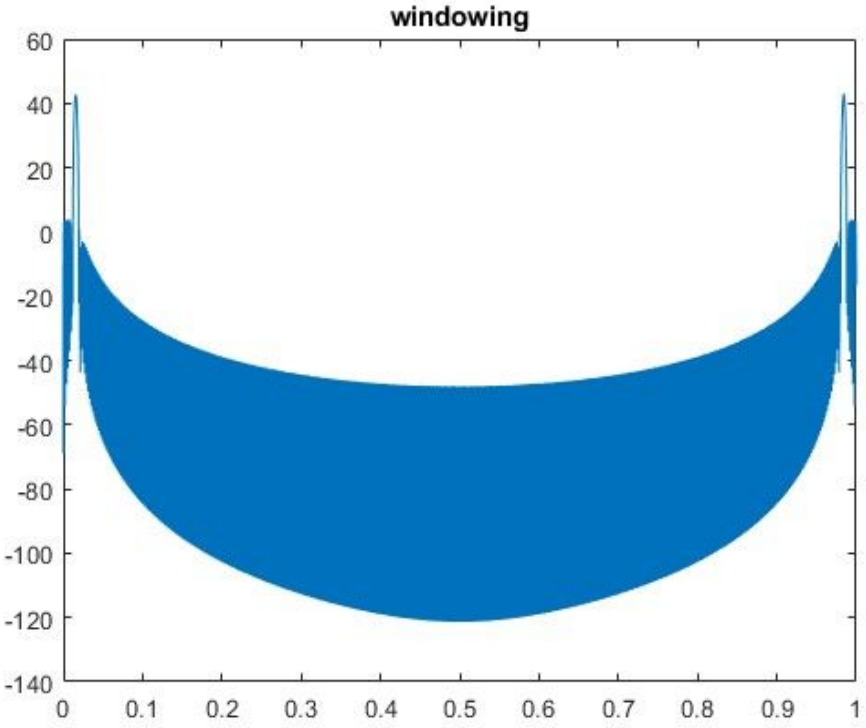



spectrum of rectwin, length 20
30
25
20
15
10
5
0
-5
-10
-15
-20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Task 7:


512 samples spectrum
300
250
200
150
100
50
0
0
100
200
300
400
500
600


zero-pad to 2048
300
250
200
150
100
50
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1




here , zero-padding and then hamming windowing (20log10 scale) was applied to obtain a better and more precise version of the plot of input signal.