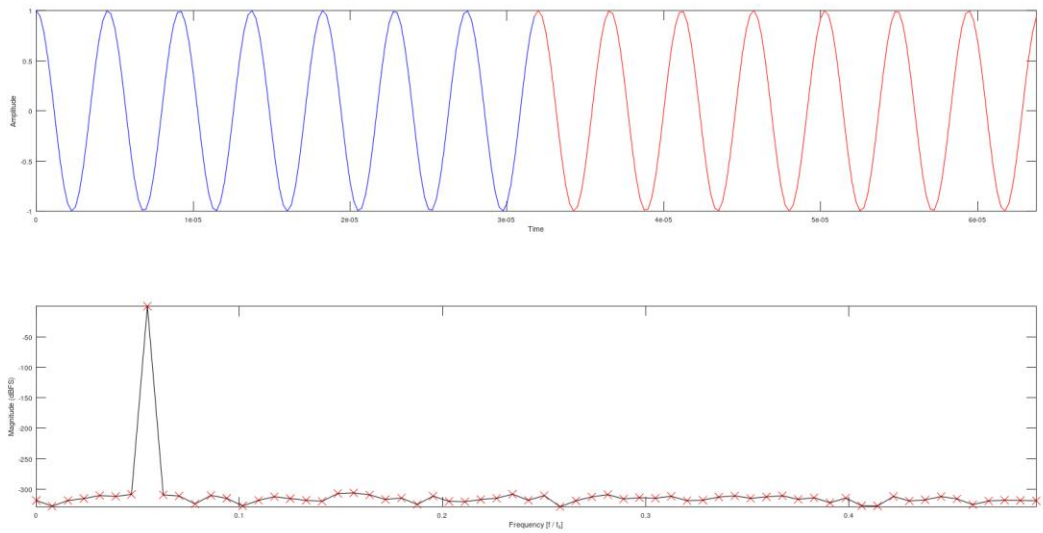
Lab 01

Part 1: Sampling and Windowing

1 Report the output plot of the included Octave code.



1.1 What is the power of the peak signal (in DBFS)?

```
>> [A,i]=max(s)
A = -1.9287e-15
i = 8
```

0 DBFS approximately as there is an error from octave itself.

1.2 How many bins are occupied by the test signal

1 bin

1.3 What is the noise floor (in dBFS)?

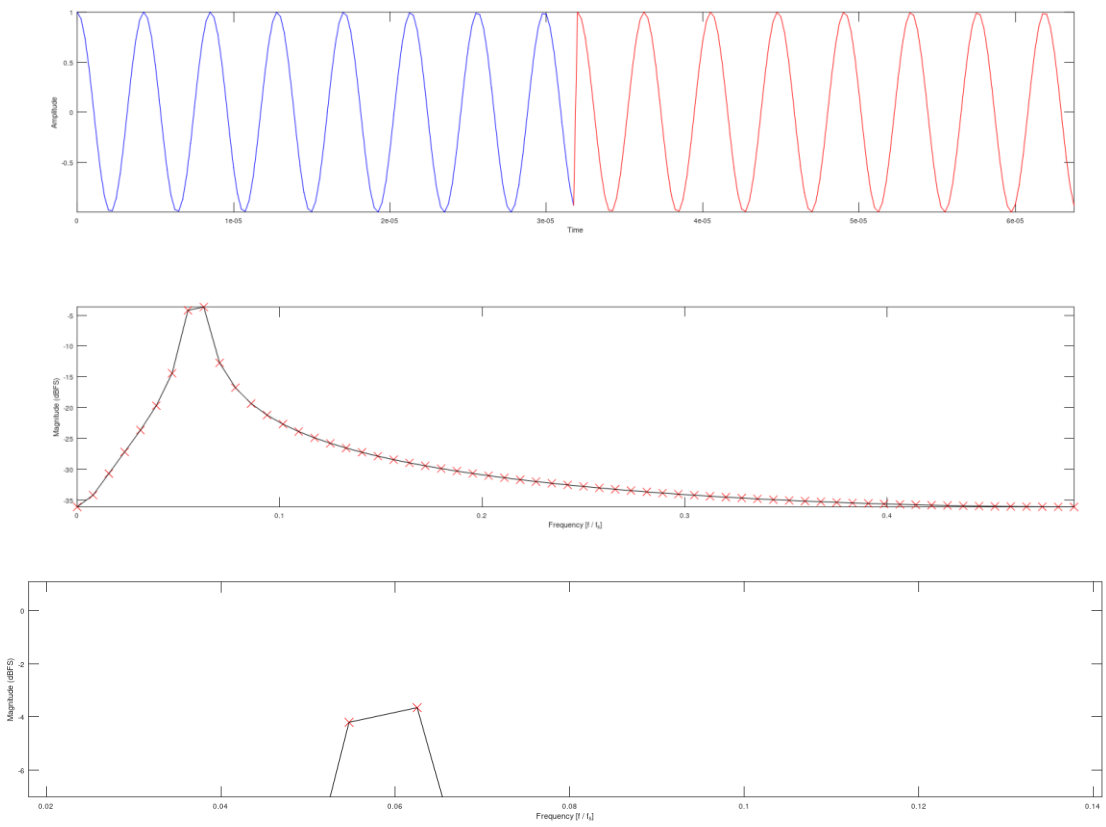
-311 dbfs .

```
>> noise= sum(s) - A
noise = -1.9911e+04
>> noise_floor = noise/64
noise_floor = -311.11
```

1.4 If the sampling is ideal, what is the source of error that causes the noise floor?

Simulation errors as the computer and fft operation itself gives us errors.

2 Change the no. of cycles to intentionally violate the coherent testing condition (Hint: Check the code comments). Report the new output plot.



2.1 What is the power of the peak signal (in dBFS)?

-3.6578 dbfs

```
>> [A I]=max(s)
A = -3.6578
I = 9
>> sig = s(I-4:I+3)
sig =

  -23.6530  -19.6855  -14.4229   -4.2117   -3.6578  -12.7328  -16.7688  -19.3423
```

```
>> power= sum(sig)
power = -114.47
```

2.2 How many bins are occupied by the test signal?

Roughly we can say 8 bins

2.3 What is the noise floor (in DBFS)?

```
>> power= sum(sig)
power = -114.47
>> noise= sum(s) - power
noise = -1818.1
>> noise_floor = noise/64
noise_floor = -28.408
>>
```

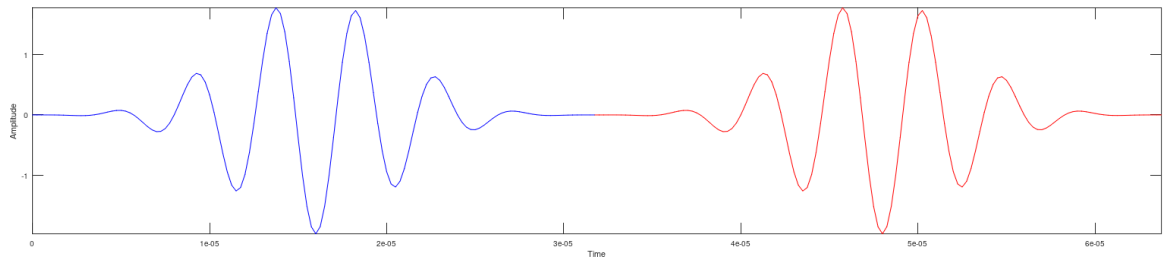
-28.408 dbfs

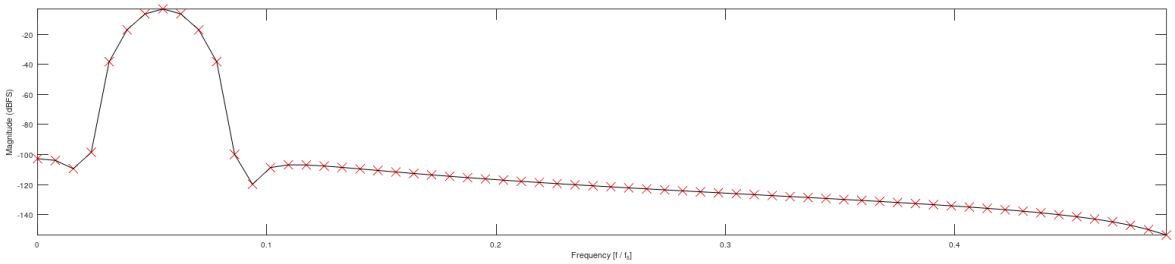
2.4 If the sampling is ideal, what is the source of error that causes the noise floor?

As Spectral Leakage happens as we violated Coherent Testing Condition, and a sudden change happens in time domain to the signal.

3 Repeat the previous two questions while applying a Blackman Harris window. (Hint: Check the code comments).

Case 1 :





3.1 What is the power of the peak signal (in dBFS)?

-3.13 dbfc

3.2 How many bins are occupied by the test signal?

```
>> [A I]=max(s)
A = -3.1309
I = 8
>> sig = s(I-3:I+3)
sig =

  -38.2008  -17.0089   -6.4210   -3.1309   -6.4210  -17.0090  -38.199

power= sum(sig)
power = -126.39
```

7 bins.

3.3 What is the noise floor (in DBFS)?

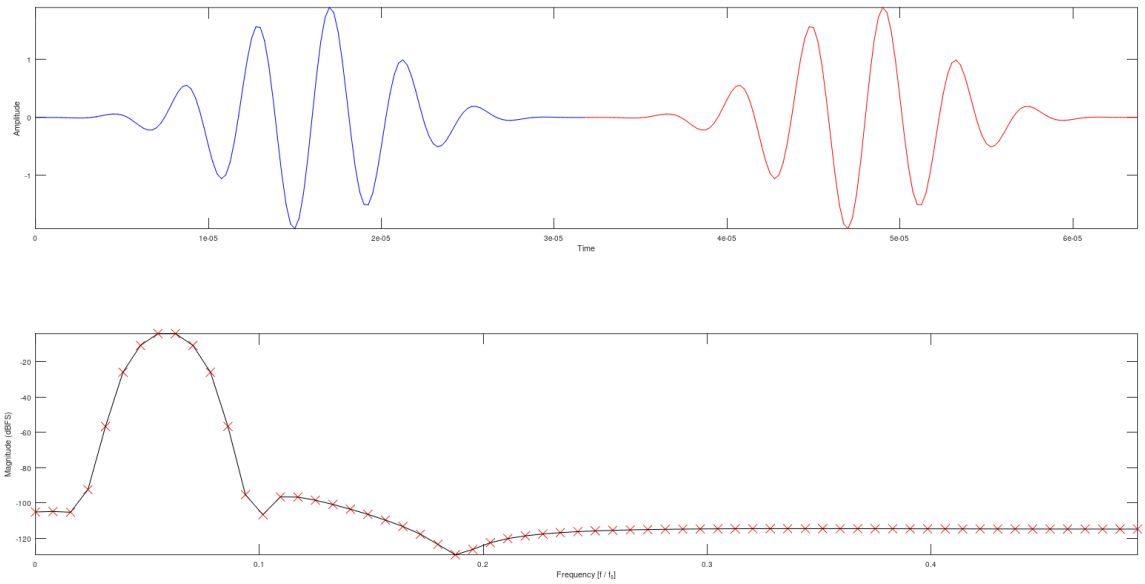
```
>> noise= sum(s) - power
noise = -7051.3
>> noise_floor = noise/64
noise_floor = -110.18
```

-110 db

3.4 If the sampling is ideal, what is the source of error that causes the noise floor?

In addition to fft simulation errors, we multiplied our sin wave with the window function in time domain so convolution happened in frequency domain, so noise floor is worse from the unwindowed case.

Case 2 :



3.5 What is the power of the peak signal (in dBFS):

-3.943 dbfc

3.6 How many bins are occupied by the test signal?

6 bins

I discarded the bins that has less than -40db.

```
>> [A I]=max(s)
A = -3.9436
I = 8
```

```
>> sig = s(I-2:I+3)
sig =

  -25.8525  -10.6912   -3.9436   -3.9436  -10.6911  -25.8533
```

3.7 What is the noise floor (in DBFS)?

-100.47 db

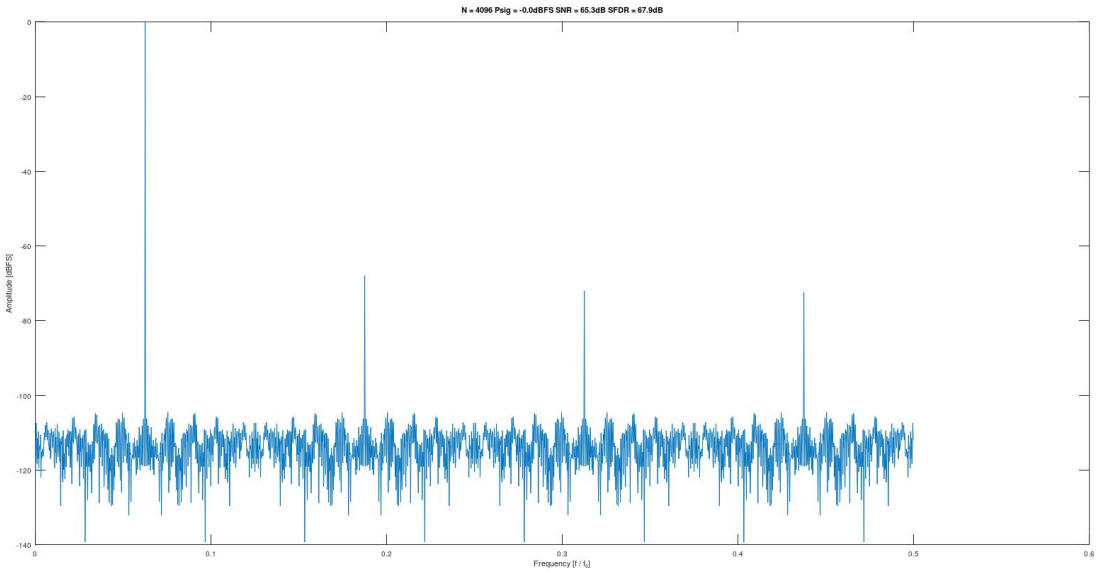
```
>> power= sum(sig)
power = -80.975
>> noise= sum(s) - power
noise = -6430.3
>> noise_floor = noise/64
noise_floor = -100.47
```

3.8 If the sampling is ideal, what is the source of error that causes the noise floor?

Also like the previous comment but with addition to that, Coherent testing condition doesn't satisfy, but the window here gives us much less noise floor from the unwindowed un cohearnt case.

Part 2: Quantization

1 Report the output plot of the included code



1.1 Do you notice distortion components? Why?

Yes, as Ncyc is even number so fin/fs is int so the error is correlated not random, so quantization noise appeared as distortion.

1.2 Calculate the SNR analytically and compare it with the SNR computed by OCTAVE.

Analytically:6.02*10+1.76=61.96 db

By octave: 65.3 db

1.3 Calculate the noise floor analytically and compare it with the noise floor in the OCTAVE plot.

In the octave plot:

-104db

analytically: $10\log S_{Q,FFT} = 10\log\frac{V_{LSB}^2}{12} - 10\log\frac{M}{2}$

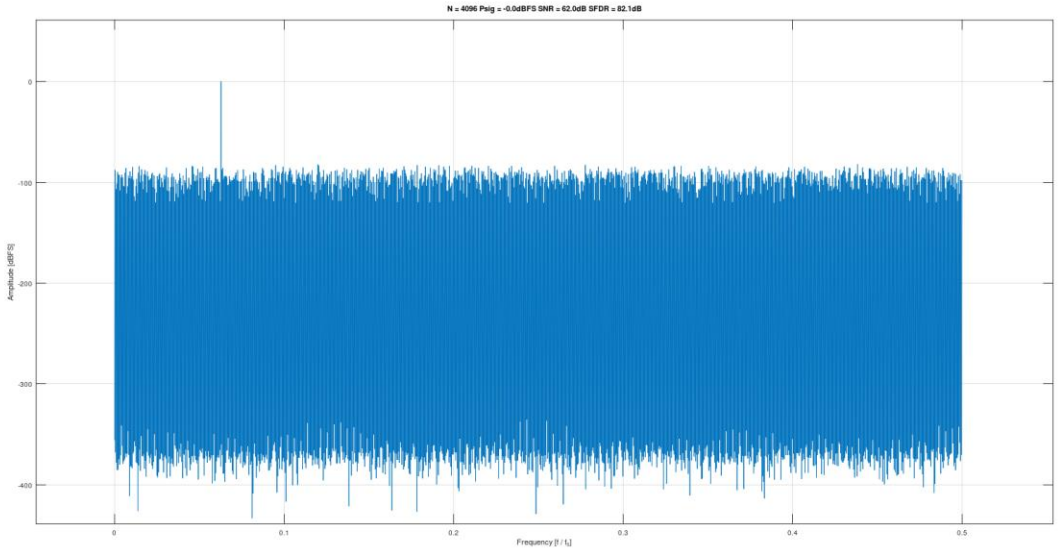
-[61.96+10log($\frac{2^{12}}{2}$)]=-95db

1.4 How much is the SFDR? Why?

67.9db, as the highest distortion at -69.7dbfs

```
>> max(20*log10(sn))
ans = -67.937
>> Psignal
Psignal = -2.4047e-03
```

2 Change the no. of cycles to satisfy the coherent testing condition (Hint: Check the code comments). Report the new output plot.



2.1 Do you notice distortion components? Why?

NO, as we chose good choice of Ncyc so fin/fs is not int and the error is random, and the coherent testing conditions being satisfied.

2.2 Calculate the SNR analytically and compare it with the SNR computed by OCTAVE.

Octave: 62db

Analytically: 6.02*10+1.76=61.96 db

2.3 Calculate the noise floor analytically and compare it with the noise floor in the OCTAVE plot.

Octave:-95.1db

Analytically: -[61.96+10log($\frac{2^{12}}{2}$)]=-95db

2.4 How much is the SFDR? Why?

82.1db, as: power signal-highest distortion component, and the highest spurious component is much lower than what it was.

3 Compare the SFDR of the two cases. Comment.

In first case = 67.9db, as the error is correlated because of the bad choice of Ncyc makes the error appears as harmonics, but when we choose Ncyc to be prime (and odd number in our case) we can see the error become random so Sfdr increased.