Zewailcity of science and technology

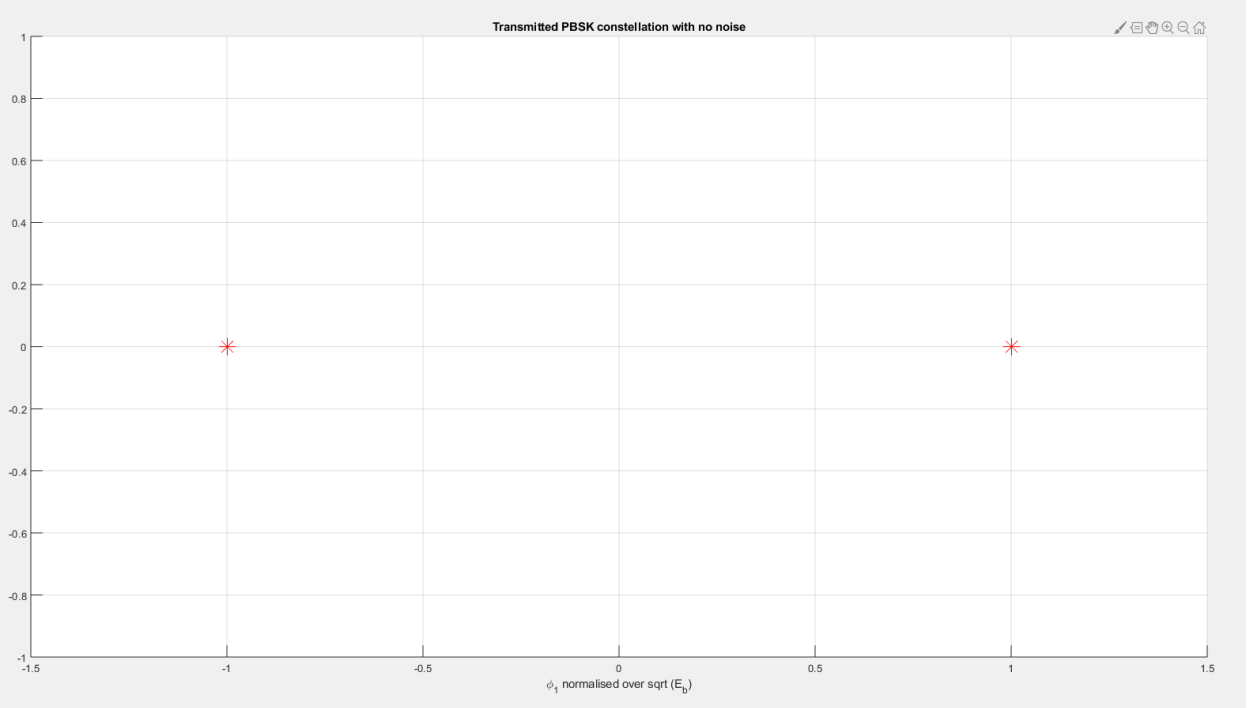
Assignment 3 Report

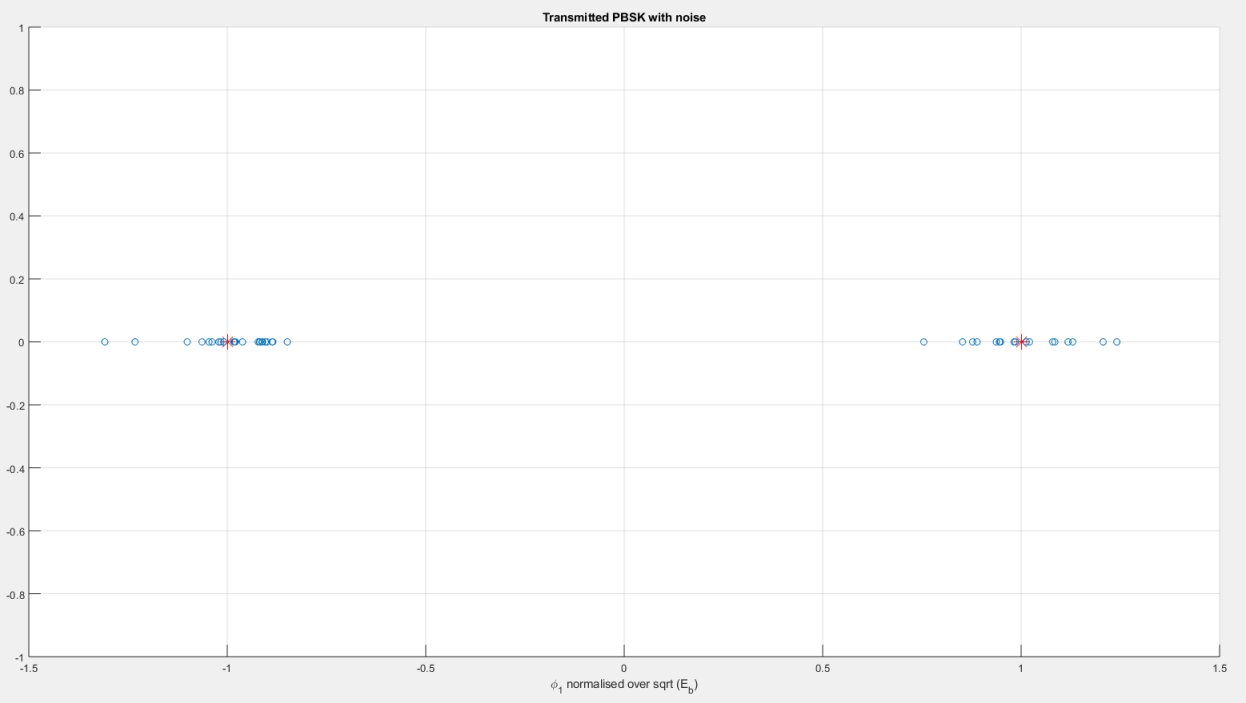
Khaled Osama Abdelhamid 201600515

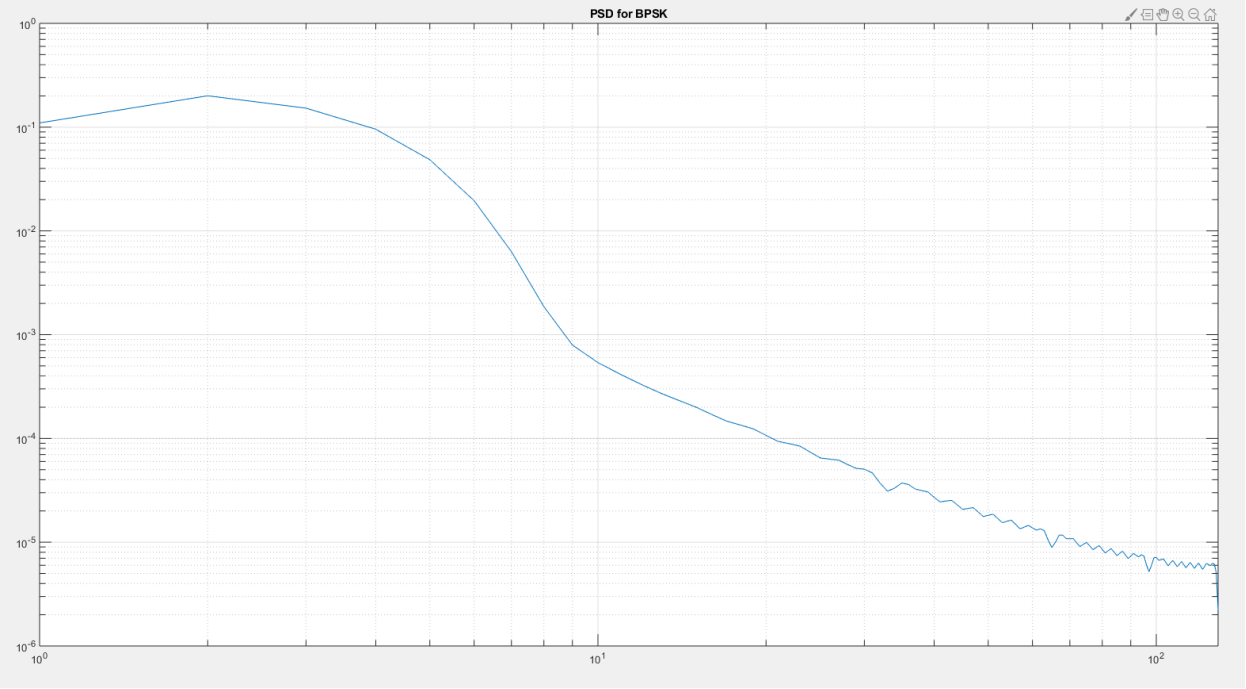
Introduction

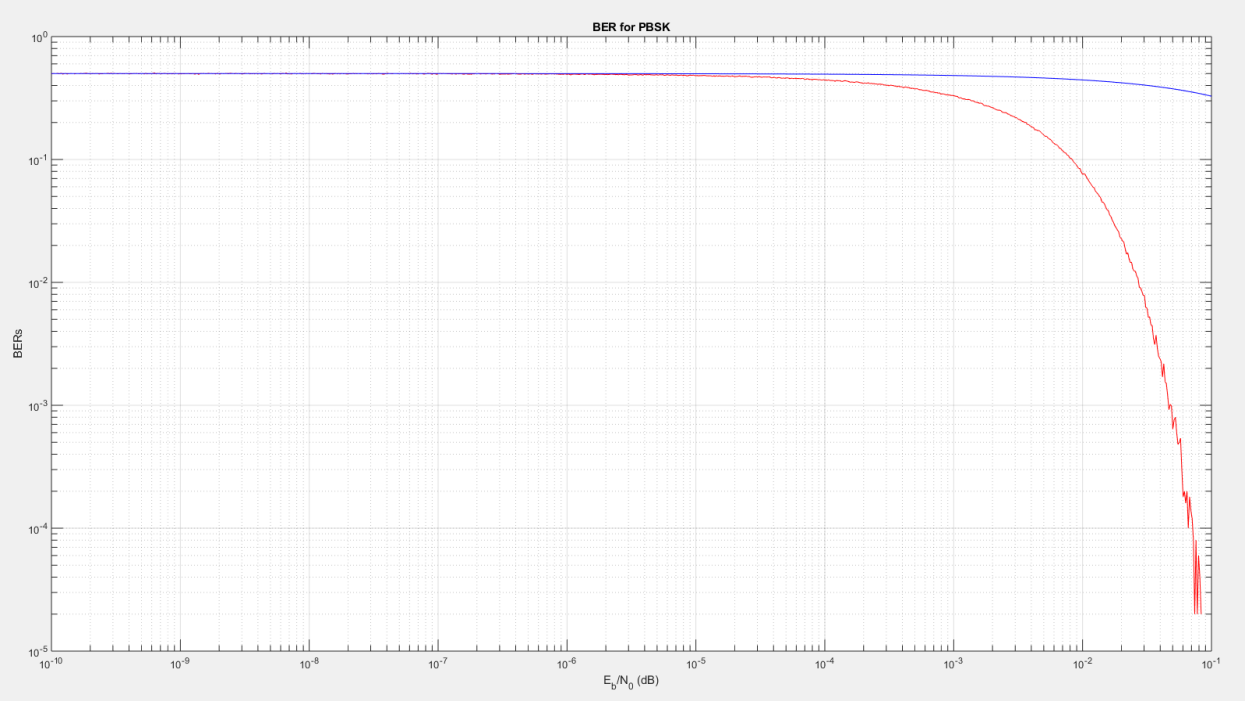
The assignment aims to implement and calculate the performance metrics for QPSK and BPSK modulation techniques. I have implemented everything from scratch as I didn't know we're allowed too use the communication toolbox, and I have reached the point of no return. However, my results are very promising as shown Below.

BPSK




Transmitted PBSK with noise
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.5
-1
-0.5
0
0.5
1
1.5
ϕ_1 normalised over sqrt (E_b)


PSD for BPSK
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^0
10^1
10^2



General comments

1- All values of the constellation have been normalized to 1 and -1

2- The more we increase N_0 the higher the variance and the received signal is more susceptible to errors. This effect is cancelled when we increase E_b.

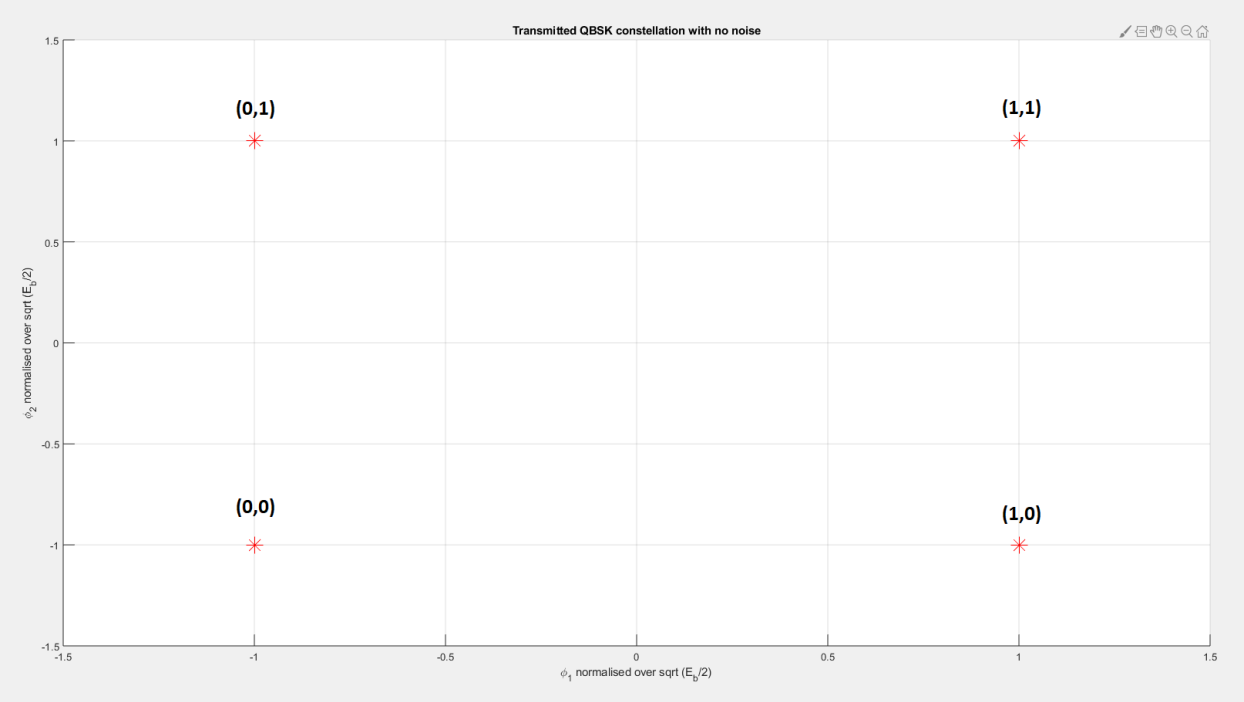
3- Due to the noise, the received values in the constellation is deviated left and right to the correct constellation points.

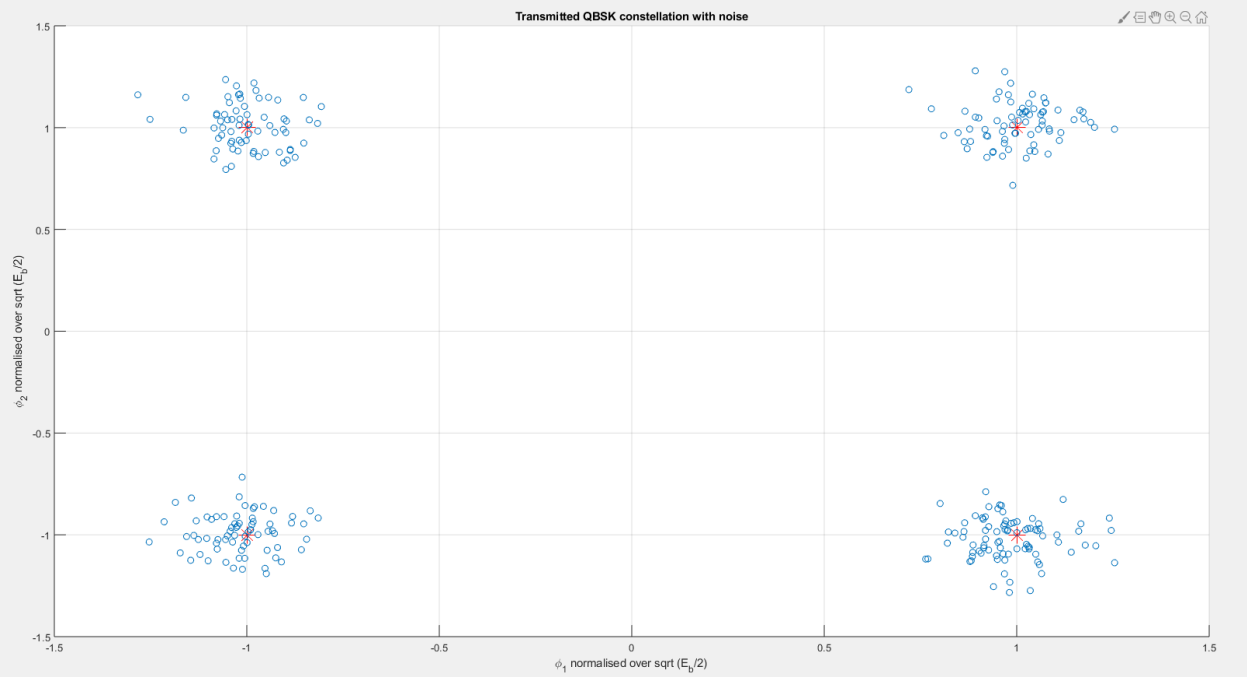
4- The BER graph matches the theoretical one until it reaches a certain limit and then it falls off dramatically. I believe this is due to the point of discontinuity at which we flip the decision from 0 to 1 or vice versa.

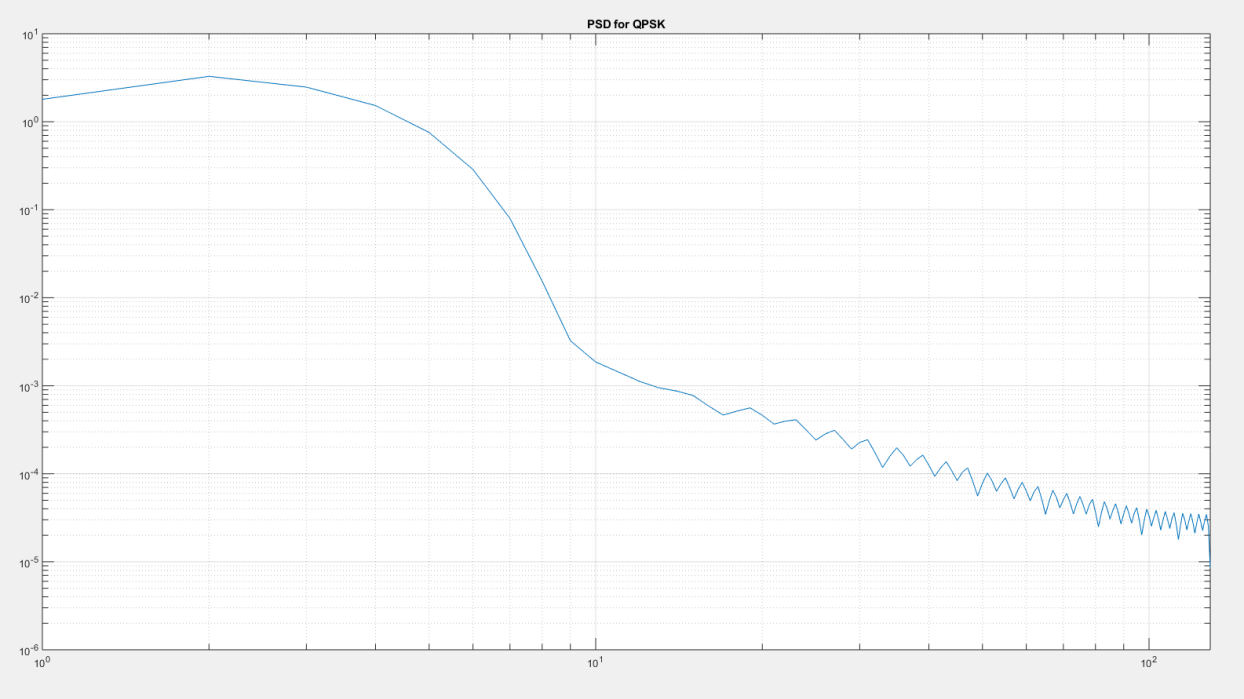
5- The oscillations in the simulation BER (Red) is due to the fact that we don't have infinite bits to test on ,rather we put some sample that may not represent long signals perfectly

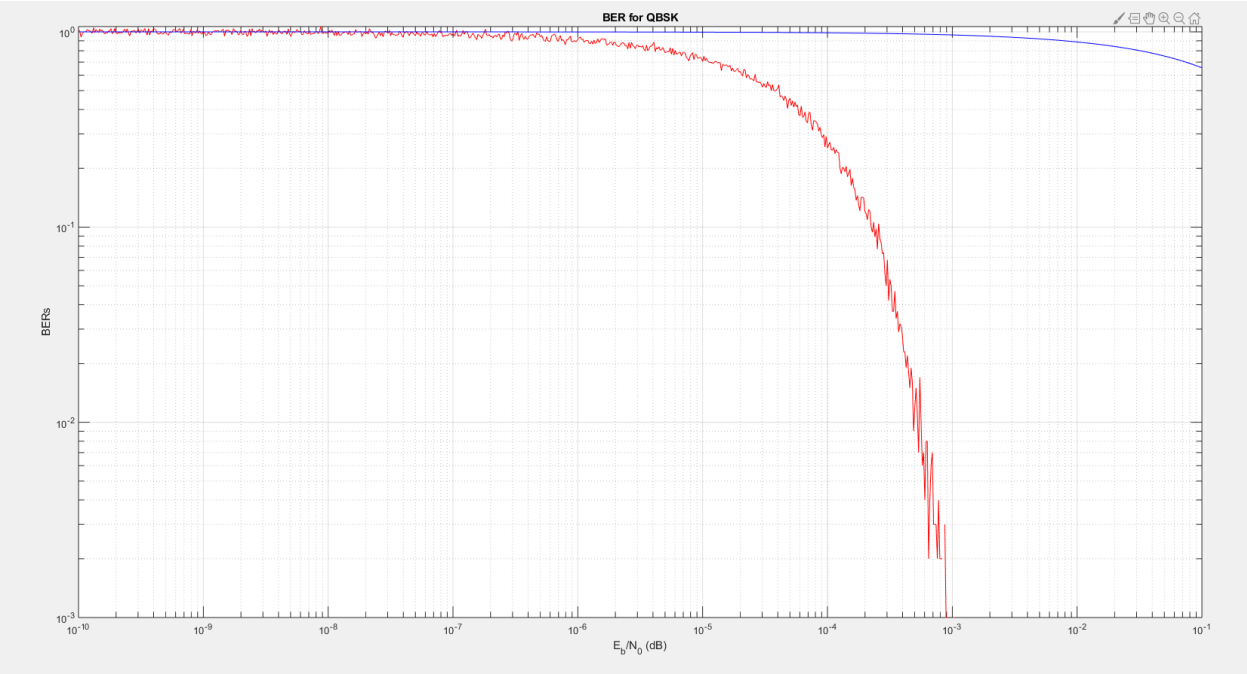
,though I have reached the limit of my hardware and couldn't add more bits (I used 2000 bits to calculate this and got 1000 BERs at different values to plot the curve).

QPSK






PSD for QPSK
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{0}
10^{1}
10^{2}


BER for QBSK
BERs
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-10}
10^{-9}
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
E_b/N_0 (dB)

General comments

1- All values of the constellation have been normalized to 1 and -1

2- The more we increase N_0 the higher the variance and the received signal is more susceptible to errors. This effect is cancelled when we increase E_b.

3- At the same Bandwidth, QPSK has half the BER of the BPSK, this means that it utilizes the BW more efficiently.

4- Due to the noise, the received values in the constellation is deviated left, right, up and down to the correct constellation points.

5- The BER graph matches the theoretical one until it reaches a certain limit and then it falls off dramatically. I believe this is due to the point of discontinuity at which we flip the decision from 0 to 1 or vice versa.

6- The oscillations in the simulation BER (Red) is due to the fact that we don't have infinite bits to test on ,rather we put some sample that may not represent long signals perfectly ,though I have reached the limit of my hardware and couldn't add more bits (I used 2000 bits to calculate this and got 1000 BERs at different values to plot the curve).

7- The BER of The QPSK falls off a lot quicker than the PBSK one. I believe that this is due to the fact that we now have more discontinuities that emerged with the second basis dimension.