MATLAB REPORT

1)

```
function y = randbit(n)
    y = randi(2,1,n) - 1;
end
```

We can use a detector based on MAP rule. The detector should detect '1' for values which are greater than a threshold. And the values below the threshold should be recognized as '0'.
The threshold can be set using MAP rule.
For a normalised curve the threshold will be 0.5, according to the variance value the threshold changes.

2)
a) **BPSK:** The mapping is done accordingly such that if bit is 0 then symbol is -1, else it is 1. The Eb value for this mapping is 1.
b) **QPSK:** In this mapping two bits are mapped to one symbol.

00 = -1 – j
01 = -1 + j
10 = 1 – j
11= 1 + j

c) **FourPam :** In this mapping two bits are mapped to one symbol

00 = (-3)
01 = (-1)
10 = 3
11 = 1

d) **sixteenqammap** : In this mapping four bits are mapped to one symbol first 2 bits represent real and others imaginary. The bit to symbol conversion of every 2 bits is same as four-pam.

e) **eightpskmap:** In this mapping three bits are mapped to one symbol. e^(j2πi/8) where, i is the decimal value of binary numbers. The average bit energy of this mapping is 1/3.

These functions are generated for each mapping and which are further used in the assignment for generating the symbols from the bits by choosing appropriate mapping.

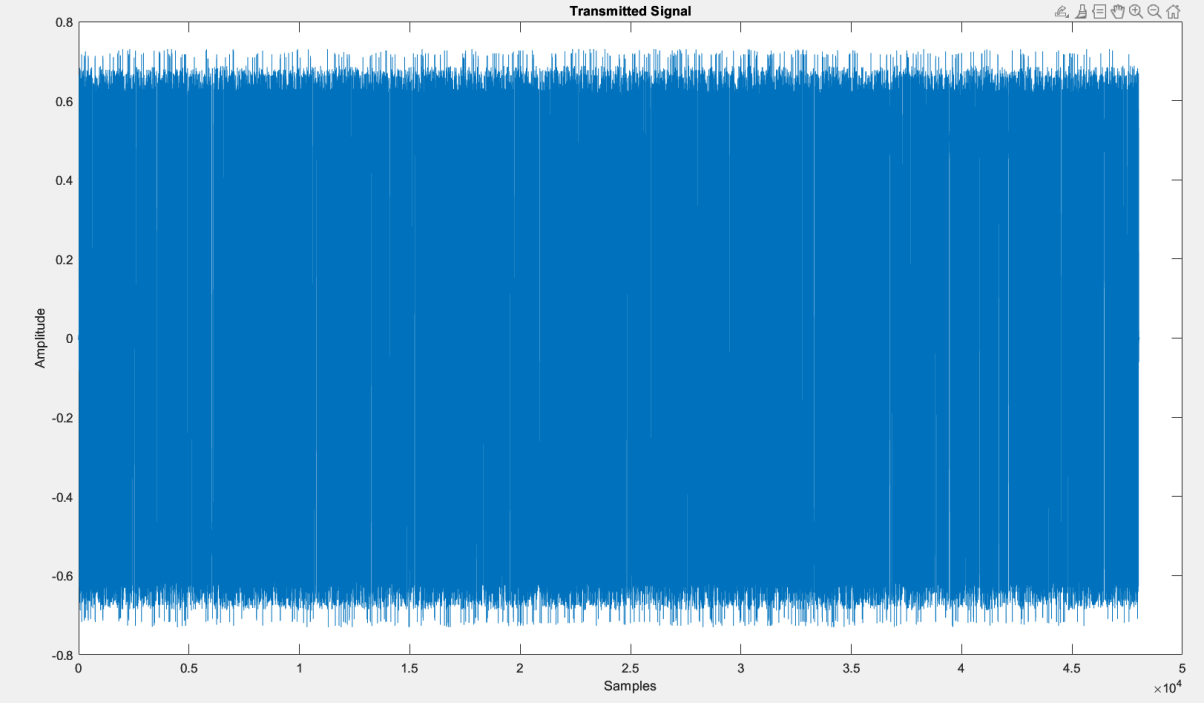
3)

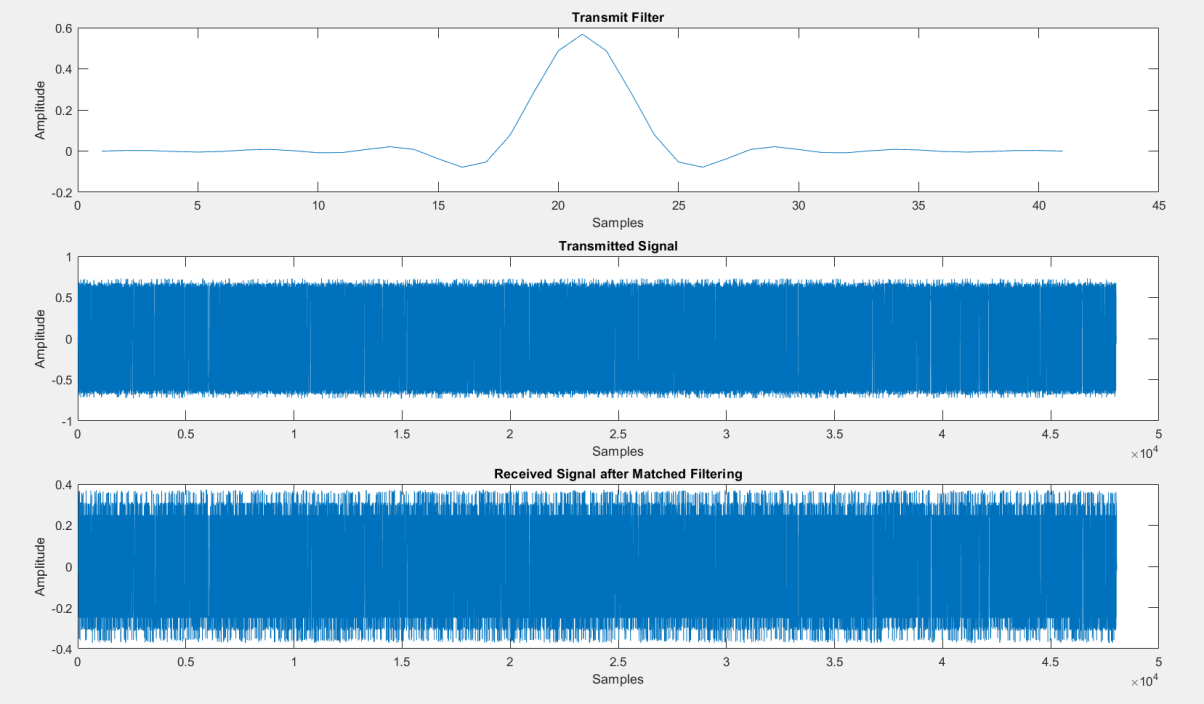
We need to generate a transmit filter and receiver filter so that |G(F)|^2 Is Nyquist we need to take a match filter to a transmitter filter. Transmit filter is

square root raised cosine it's match filter is same. So, the receiver filter is also square root raised cosine.

The sq root raised cosine is generated by using a matlab function- "rcosdesign()".

Filter has sampling freq 4 times the sampling rate of bits. It is designed accordingly

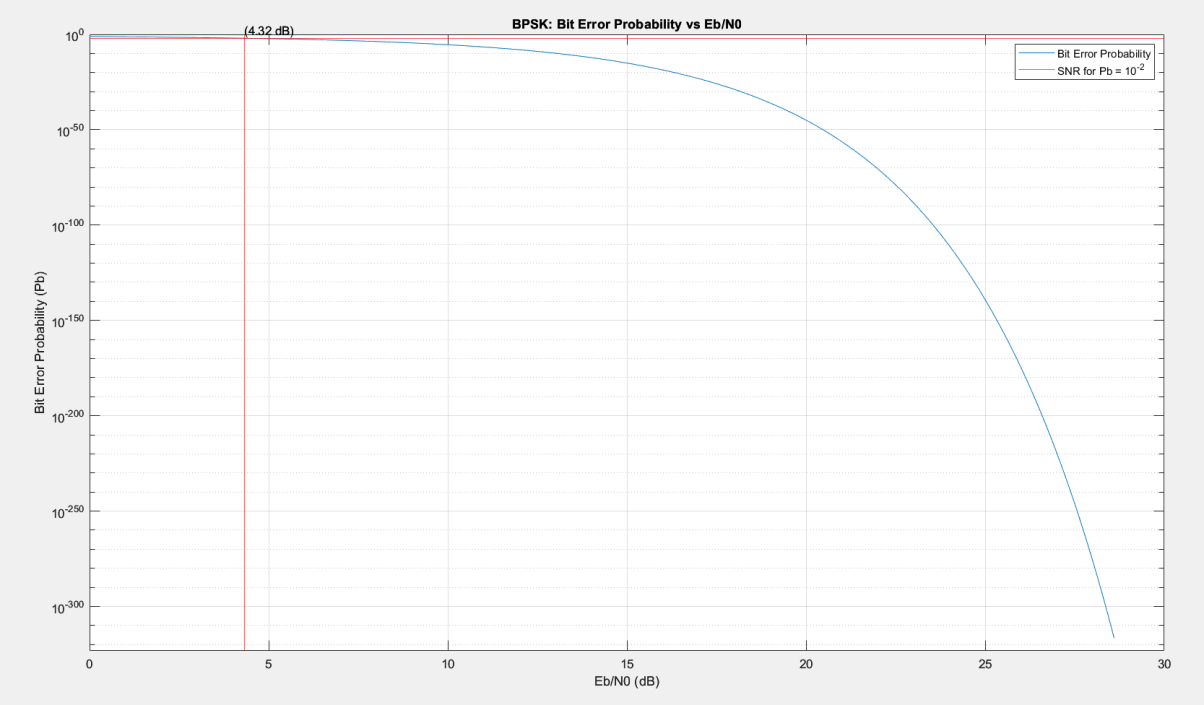




4)

In real life there will be noise it is modelled as gaussian and added to transmitter output to generate real time simulation. We can check its working in the 6th question

5)



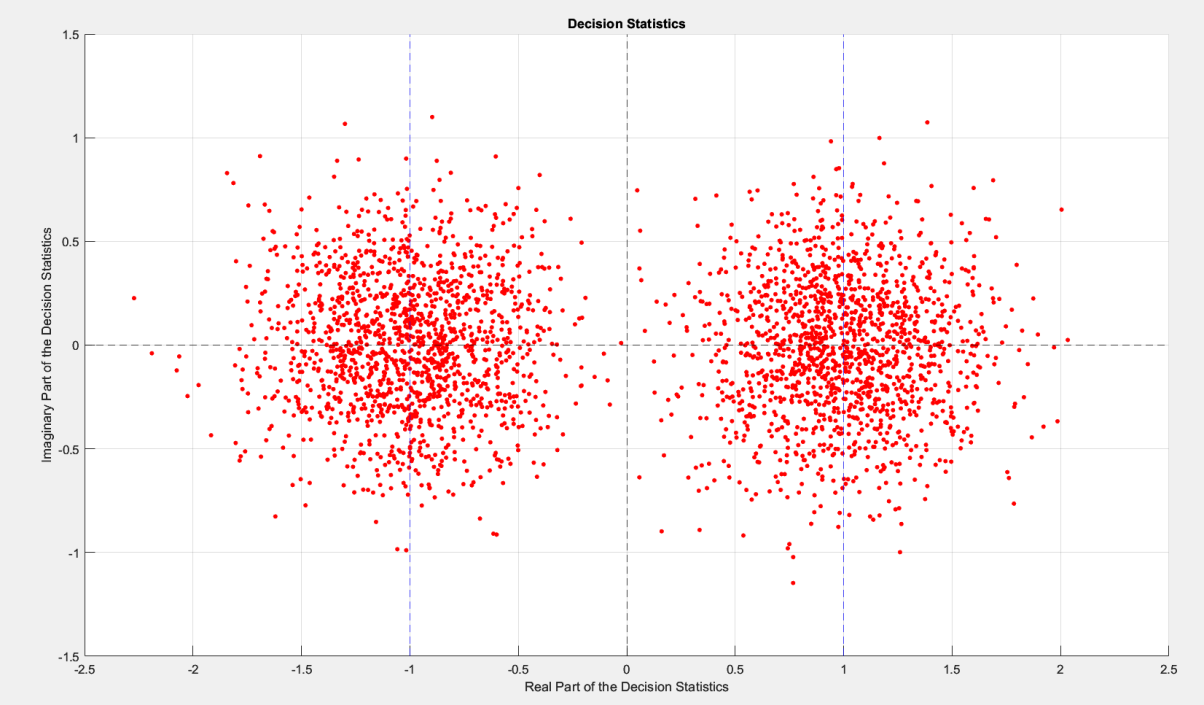
The graph is generated using qfunc() an inbuilt matlab function.
For error probability =0.01 the obtained value of signal to noise ratio is 2.7059

6)

Before doing the Sampling we need to remove the extra padding part which is obtained due to convolution.
The extra part will be of length half of size of the filter, this is because the mid-point of the filter should overlap with the symbols. Until that point there will be no overlapping of symbols at p(0) of the filter.

For the above value of N0 we get Variance i.e. N0/2 . Now we can model the noise as we know the sigma value. N0 = 0.3696.

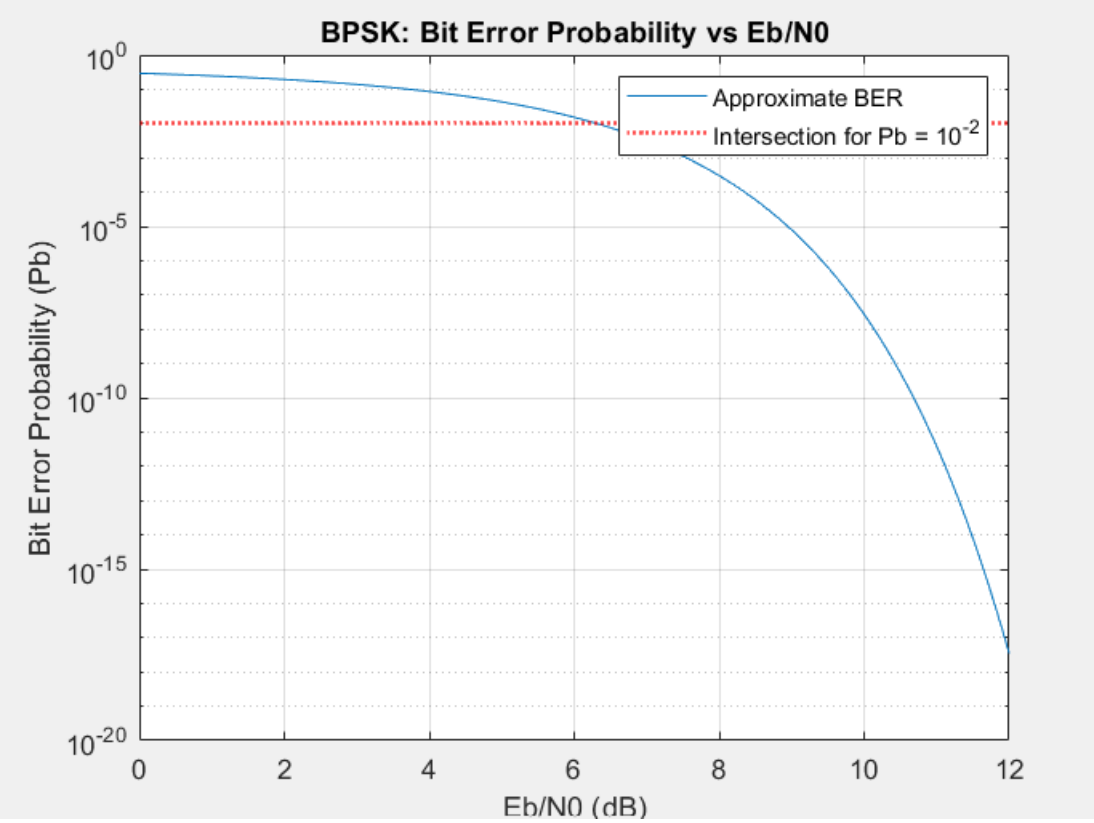
For bpsk the input and output of the receiver when the noise added to the system is :



7)

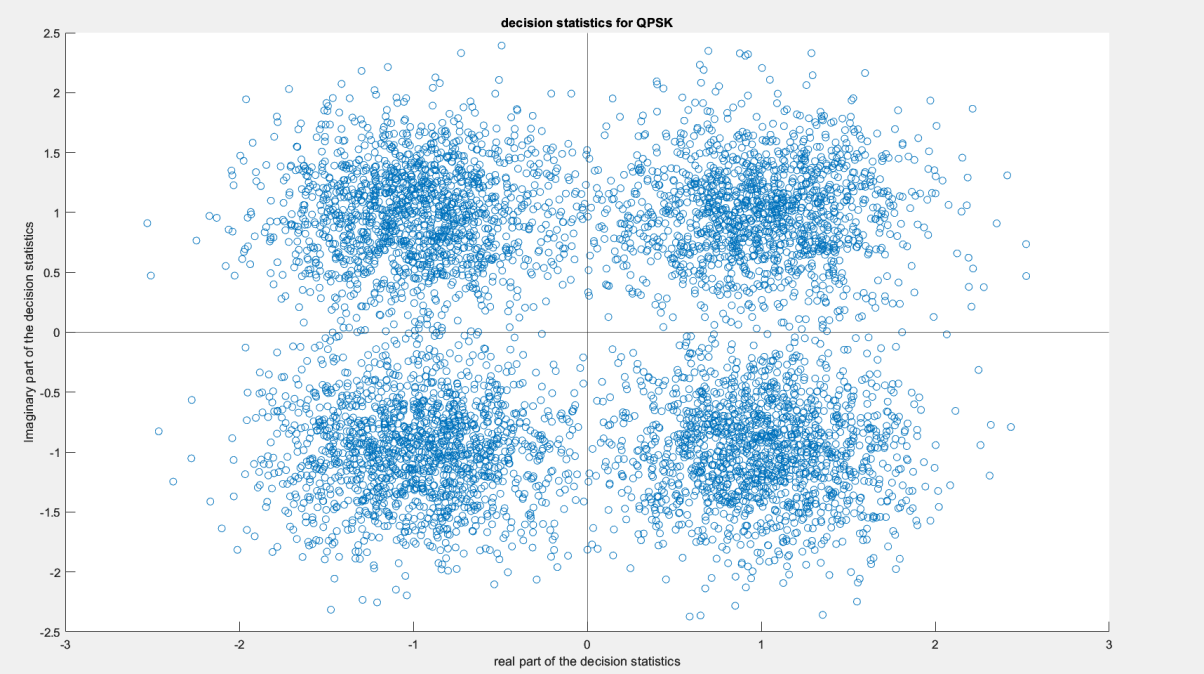
```
error_tx =

    0.5025


error_rx =

    0.0115
```

8) Eb/N0 for Pb = 1e-2: 6.3141 dB


BPSK: Bit Error Probability vs Eb/N0
Approximate BER
Intersection for Pb = 10^-2
Bit Error Probability (Pb)
Eb/N0 (dB)
10^0
10^-5
10^-10
10^-15
10^-20
0
2
4
6
8
10
12

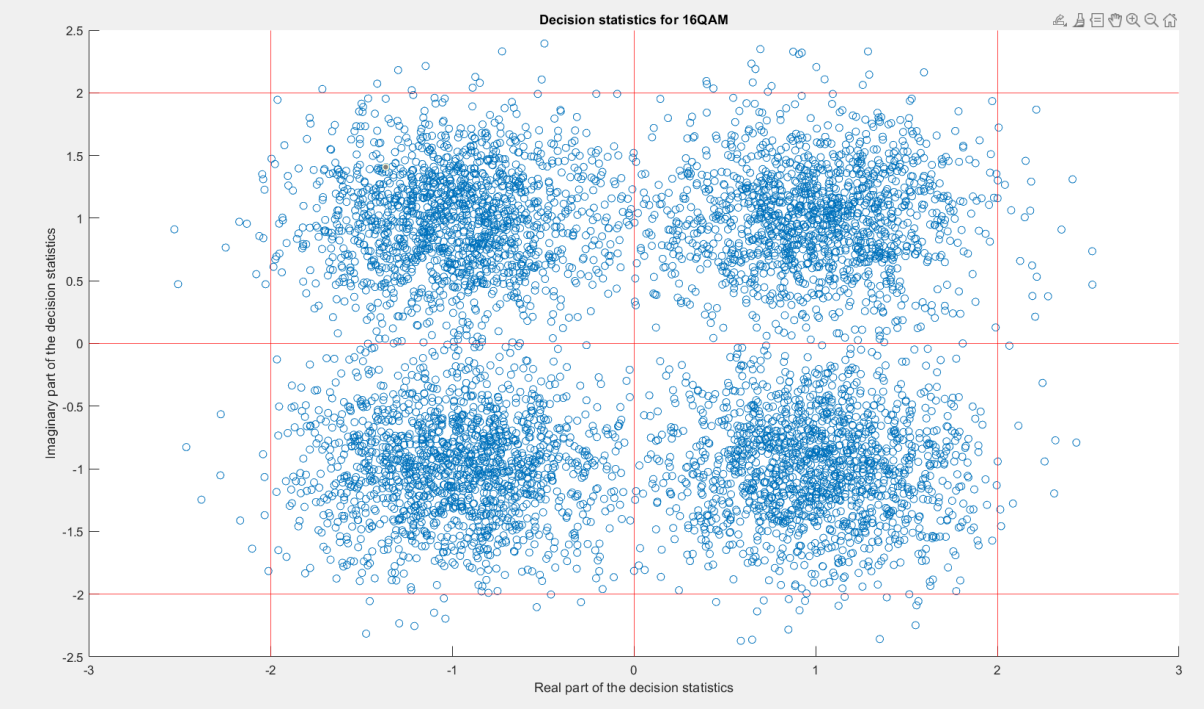
9)


Decision Statistics for 4PAM
Imaginary Part of the Decision Statistics
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2



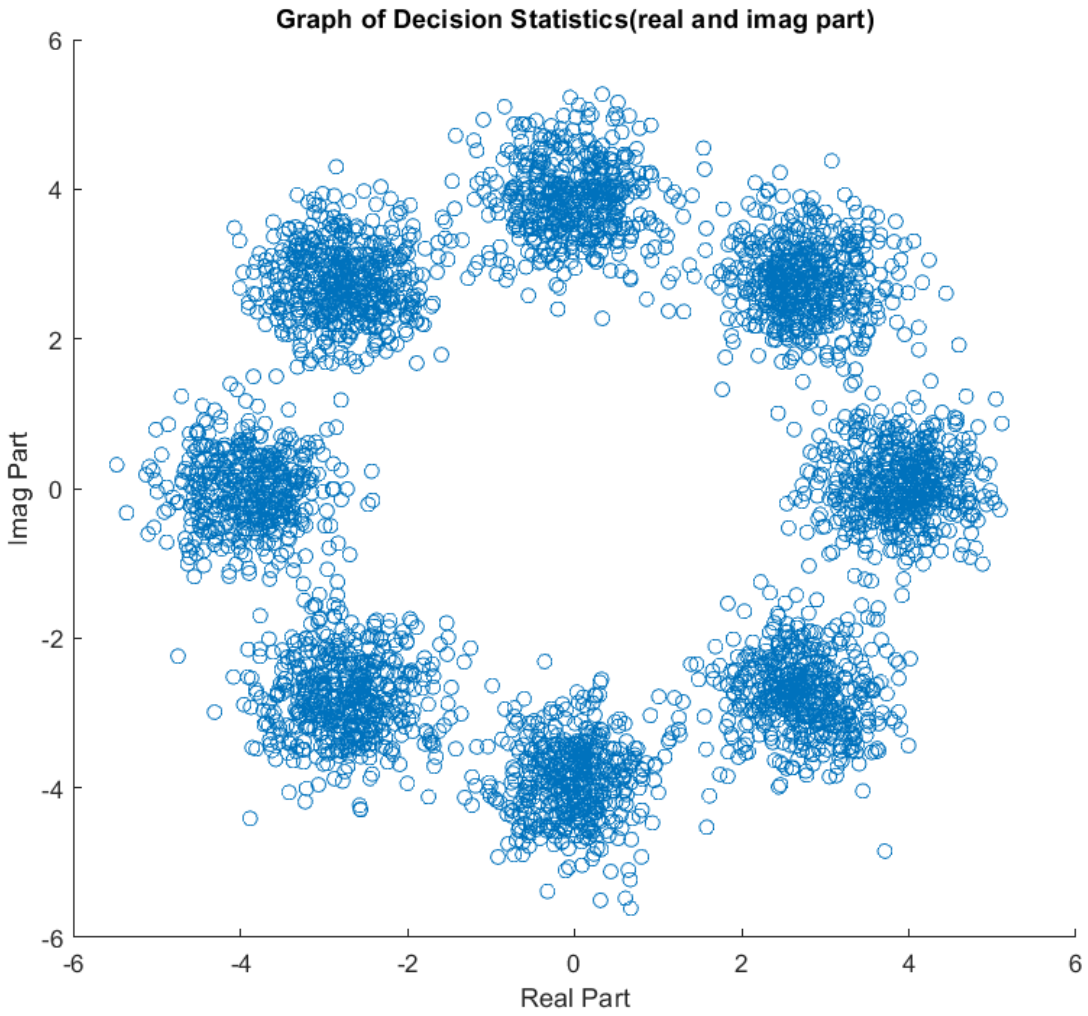
10)

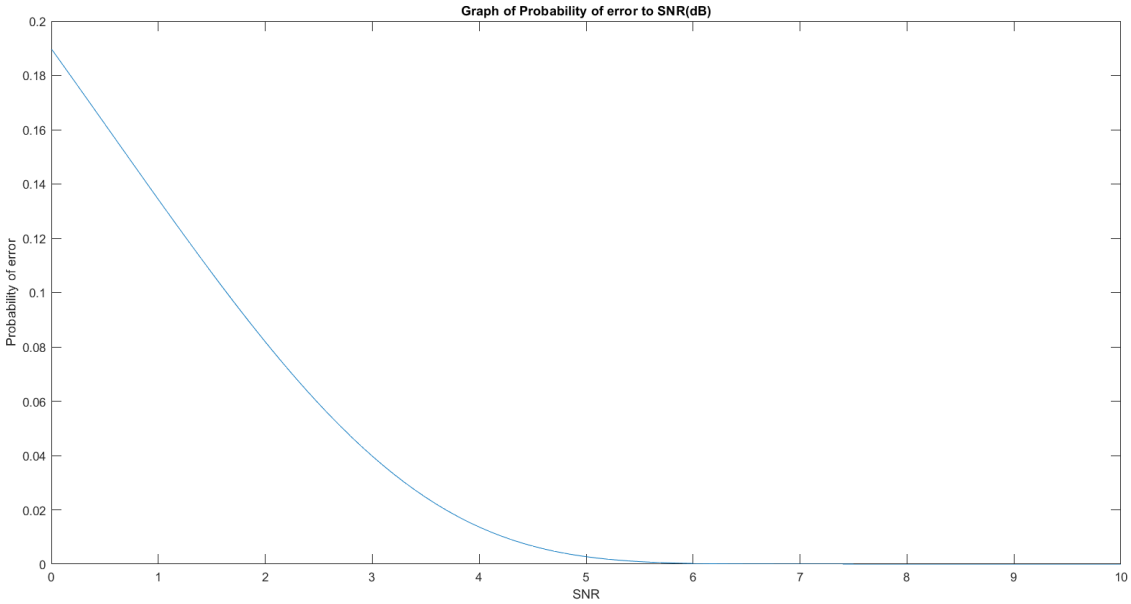
```
>> q10
Symbol Error Rate: 1
Bit Error Rate: 0.1
```



11)

```
err =

    3.4992e+03
```


Graph of Decision Statistics(real and imag part)
Imag Part
Real Part
6
4
2
0
-2
-4
-6
-6
-4
-2
0
2
4
6


Graph of Probability of error to SNR(dB)
Probability of error
SNR
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
1
2
3
4
5
6
7
8
9
10