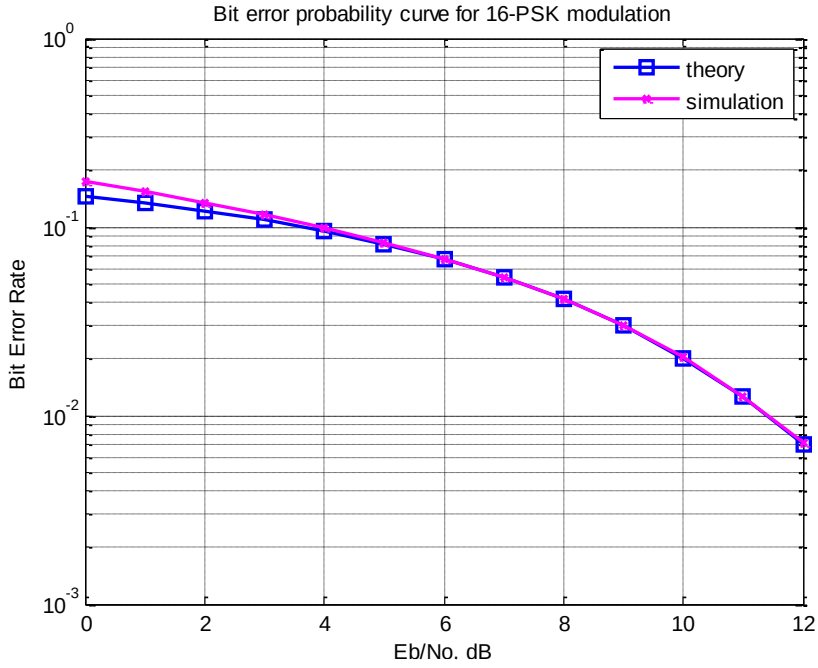
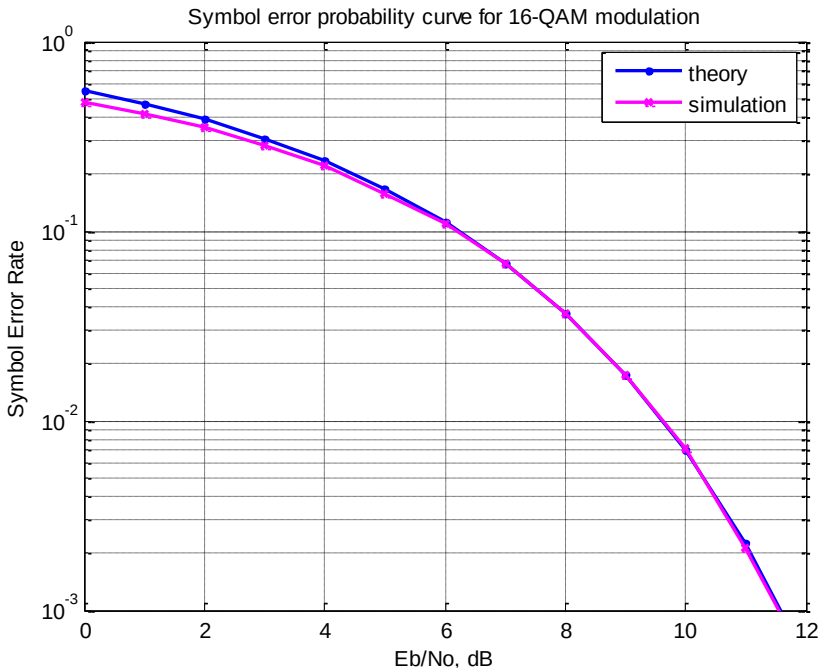
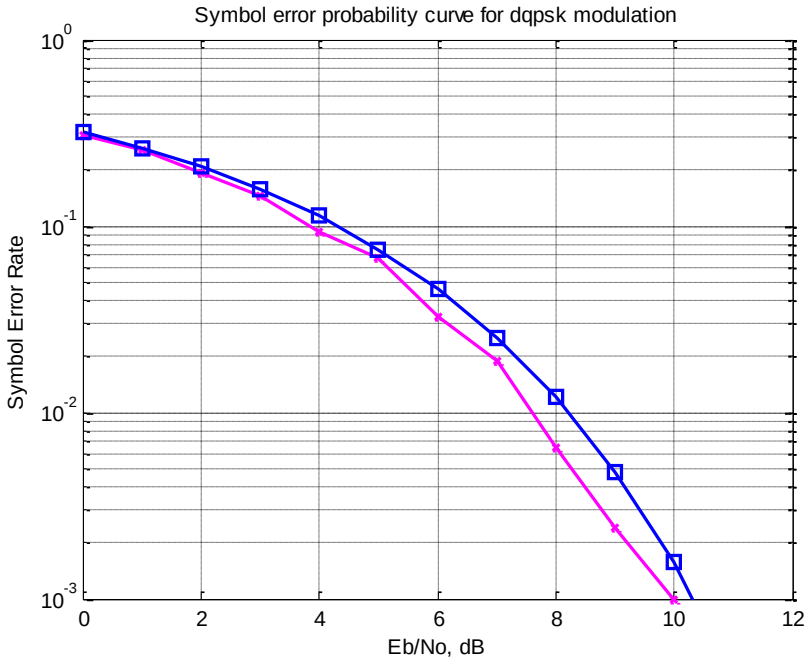
Q1.

a) For 16-PSK and 16-QAM modulation, the error probability is respectively as below figures. According to the results, error probability plot for QAM with increasing SNR drops more compared to the PSK chart.





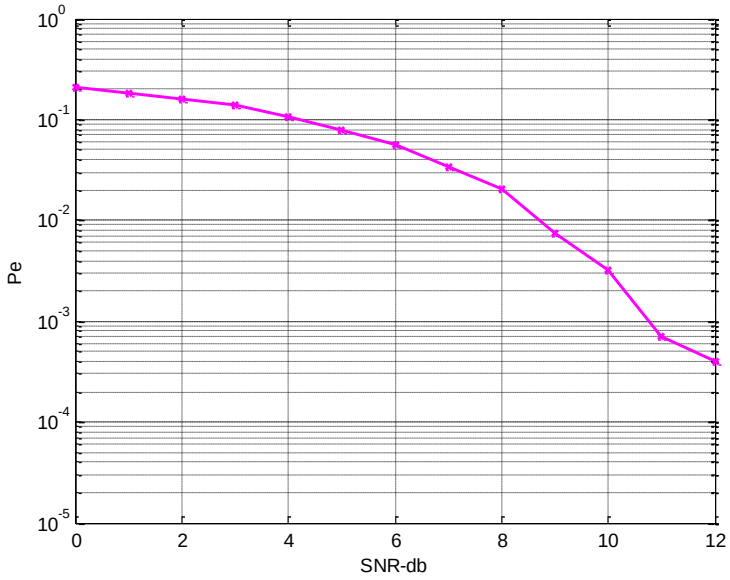
b) Below figure shows DQPSK modulation error probability. The blue scheme is theoretical result and the pink scheme shows simulation result.



Q2.

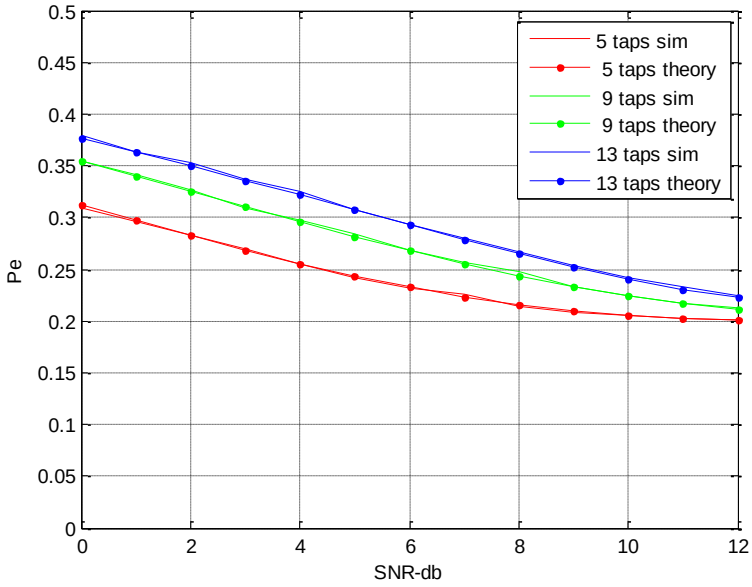
a) Viterbi

For the Viterbi algorithm, the error graph versus SNR is as shown below.

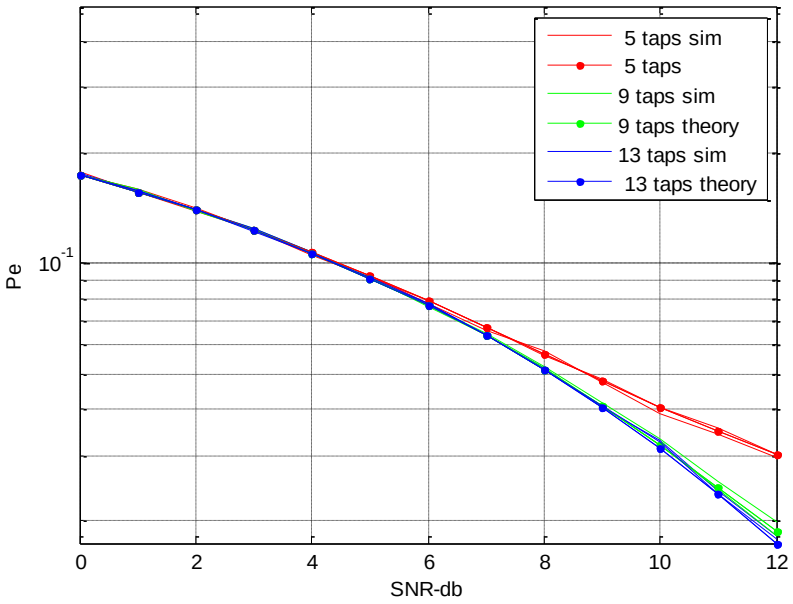


b) ZF

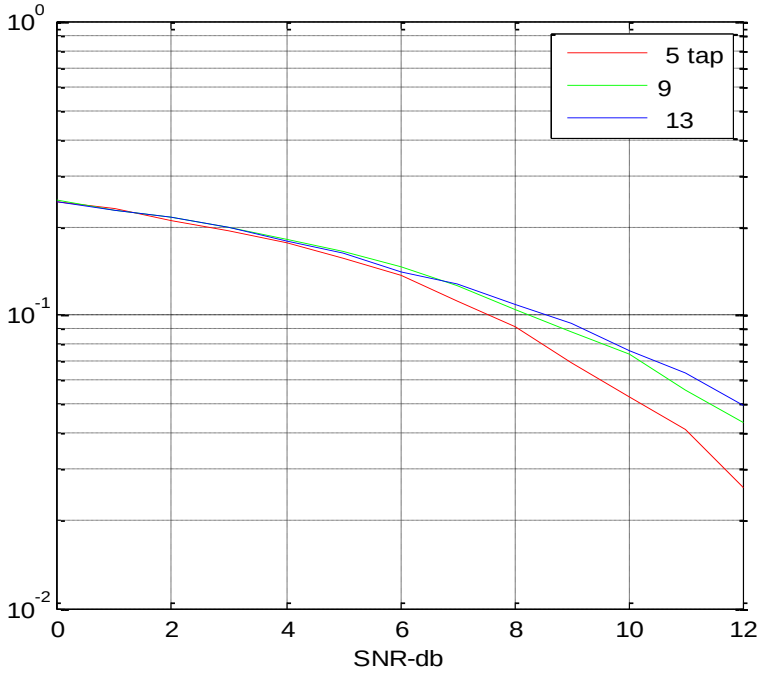
For ZF with taps 5, 9, and 13, the following three graphs have been presented for both theory and simulation modes.



c) MMSE


5 taps sim
5 taps
9 taps sim
9 taps theory
13 taps sim
13 taps theory
Pe
10^{-1}
0
2
4
6
8
10
12
SNR-db

d) DFE


5 tap
9
13
10^{0}
10^{-1}
10^{-2}
0
2
4
6
8
10
12
SNR-db

e) Comparison

By comparing the graphs, we can see that the Viterbi algorithm is superior to other methods, that the solutions get better as its depth increases, but ZF performs poorly compared to others. DFE and MMSE also perform well at low SNR and their efficiency decreases with increasing SNR.