

# Comparison Digital Modulation Techniques

This aim of this mini-project is to compare some of the Digital Modulation techniques in terms of their Bit Error Rates and Symbol Error Rates in presence of Additive White Gaussian Noise. MATLAB based SIMULINK models are prepared in each case. For theoretical background relevant sections of chapters 6, 11 and 13 of the book **Principles of Communication Systems, 3e** by Herbert Taub, Donald L Schilling and Goutam Saha.

(**Acknowledgement** : The mini project is successfully completed under my guidance and the report is prepared by my M.Tech. student, Mr. Arindam Sanyal at IIT Kharagpur.)

The block diagrams for the various digital modulation techniques as implemented in Simulink are shown below:

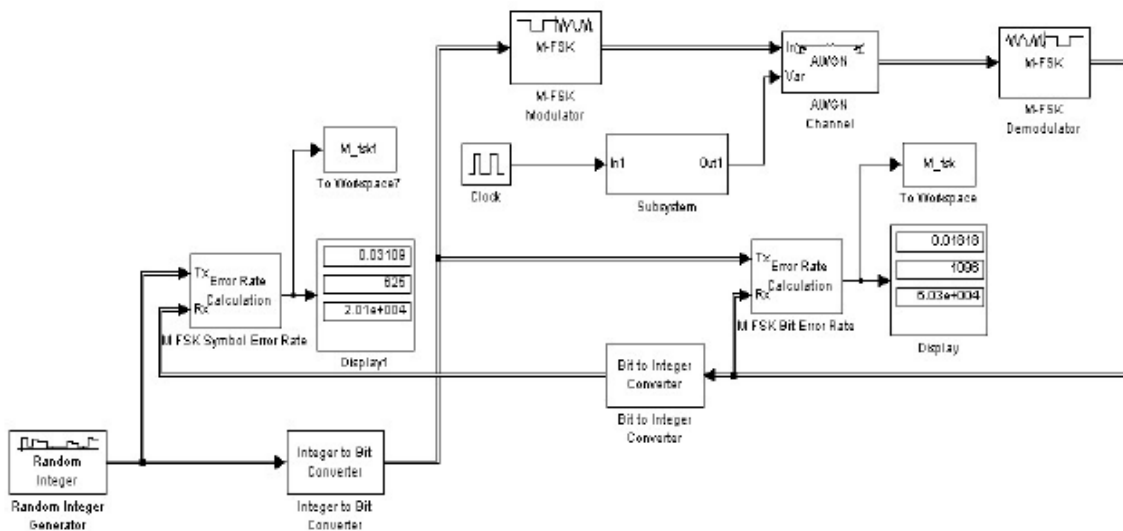


Fig. 1 Block Diagram for M-Ary FSK(M=8)

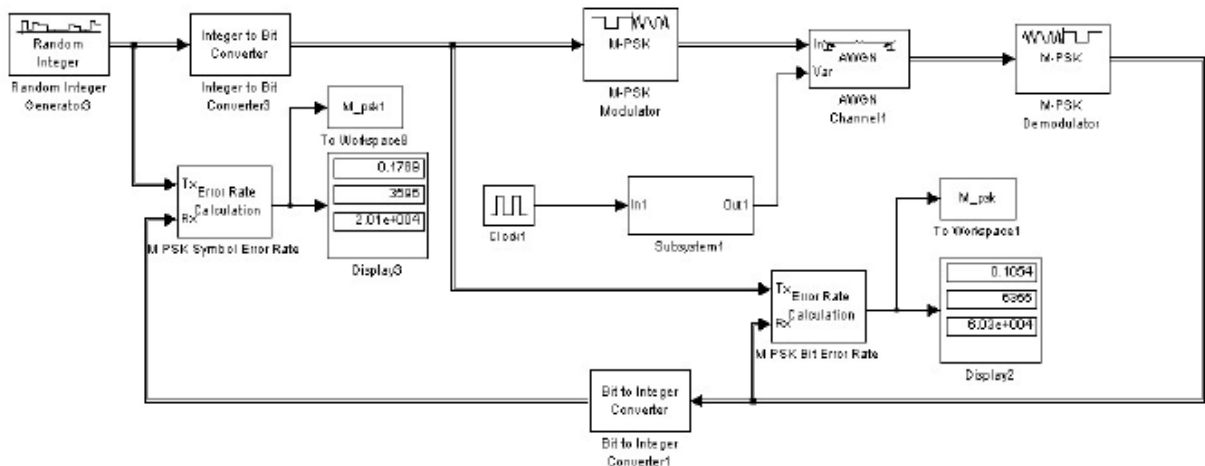


Fig. 2 Block Diagram for M-Ary PSK(M=8)

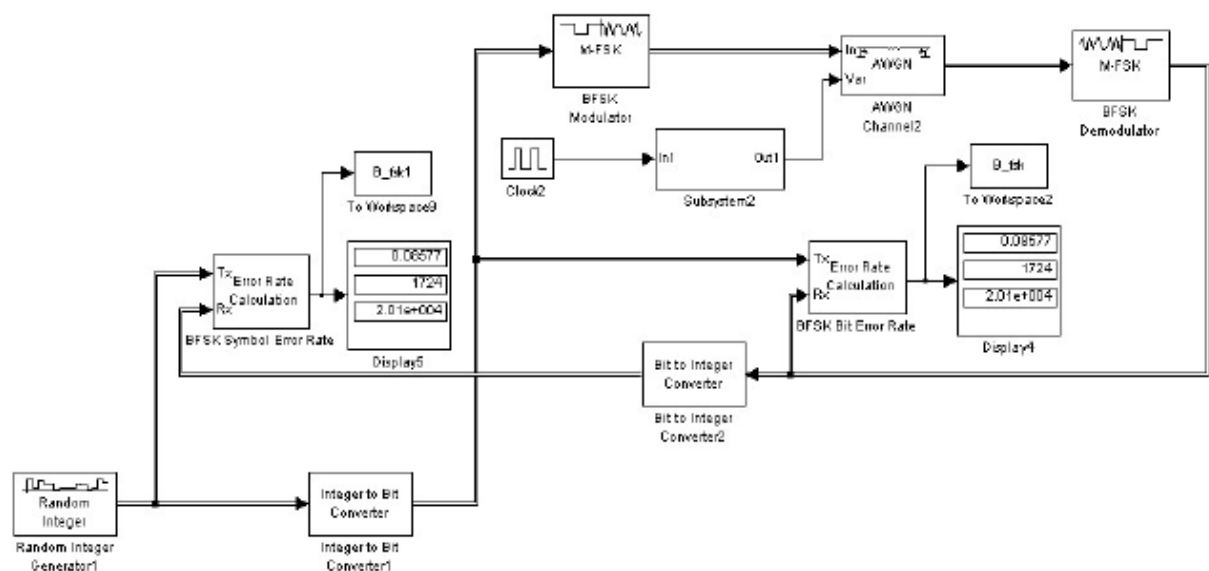


Fig. 3 Block Diagram for BFSK

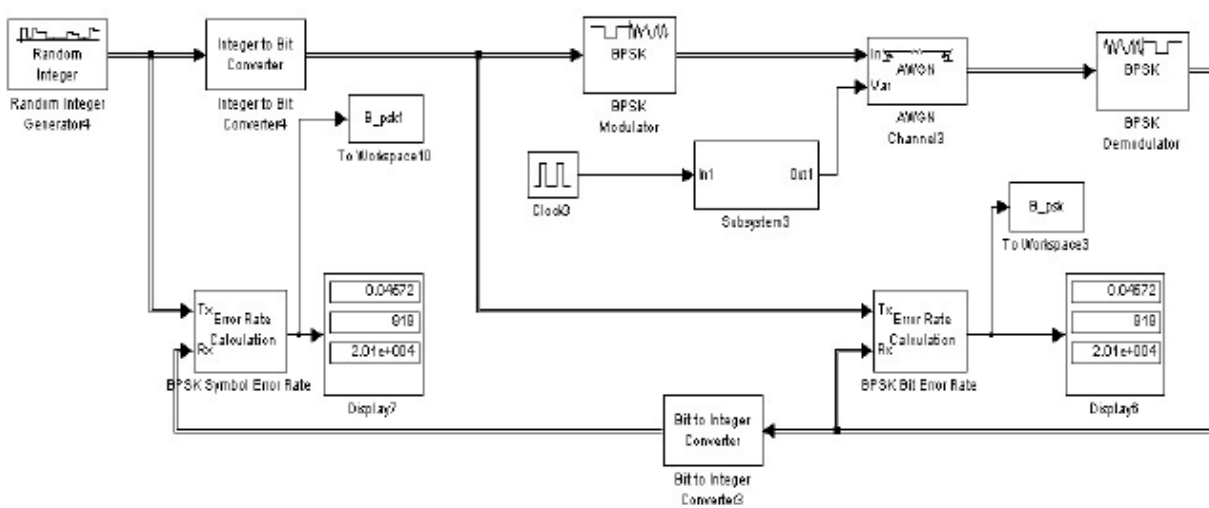


Fig. 4 Block Diagram for BPSK

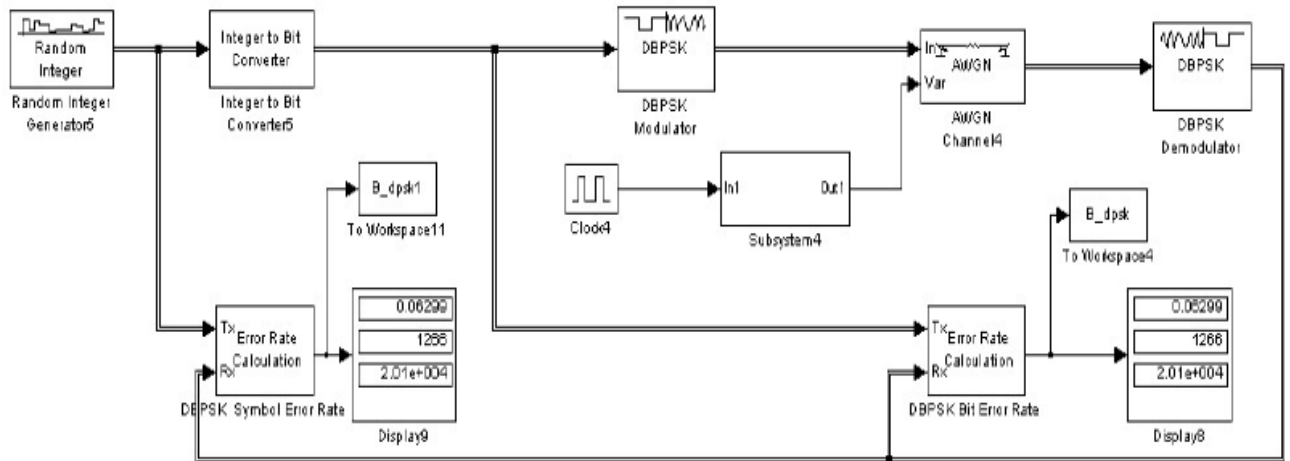


Fig. 5 Block Diagram for DBPSK

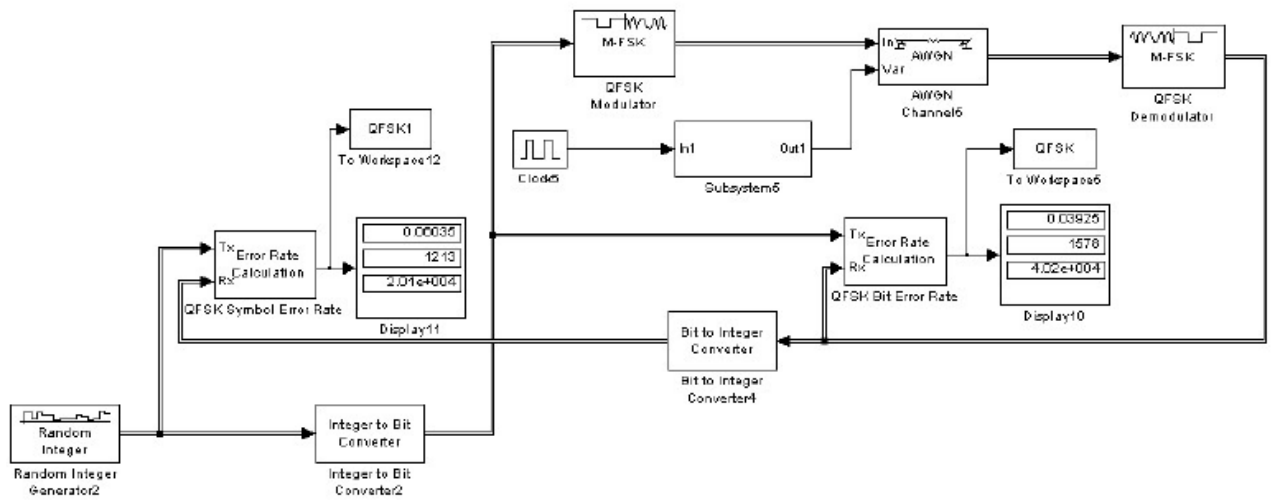


Fig. 6 Block Diagram for QFSK

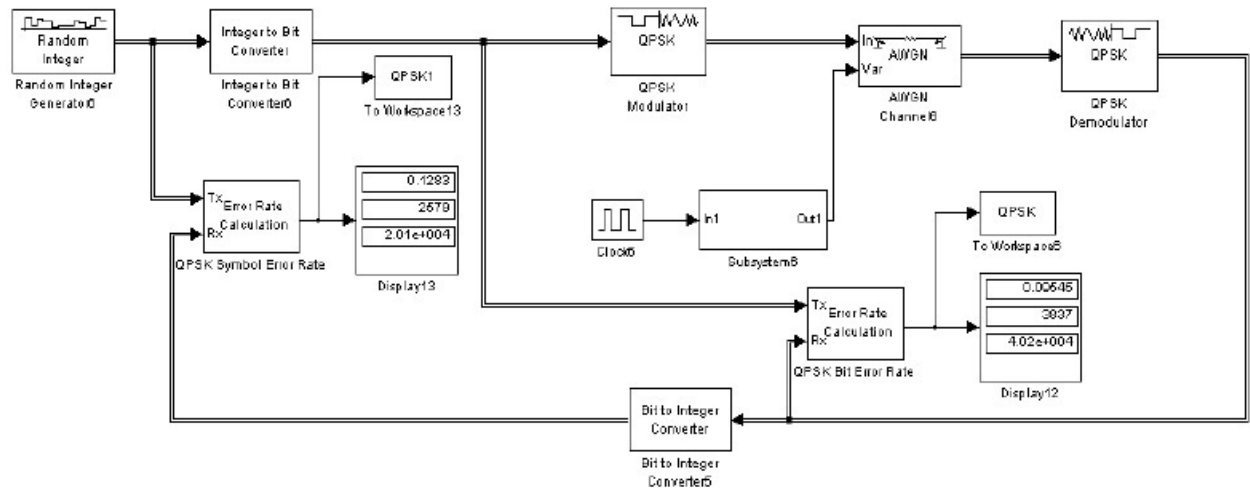


Fig. 7 Block Diagram for QPSK

The data sequence is generated using a random integer block the output of which is then converted into bits, using the integer-to-bit block.

- The various baseband digital modulation (and demodulation) blocks are used to perform the modulation and demodulation at the transmitter and receiver ends.
- The effect of channel noise is modeled using a AWGN channel block.
- Bit error rates and Symbol error rates are calculated using the Error rate block.
- The variance of the AWGN noise is varied using a subsystem which is shown below. The bit error rates and the symbol error rates obtained by varying the  $E_s/N_0$  ratio is written to the workspace for plotting.

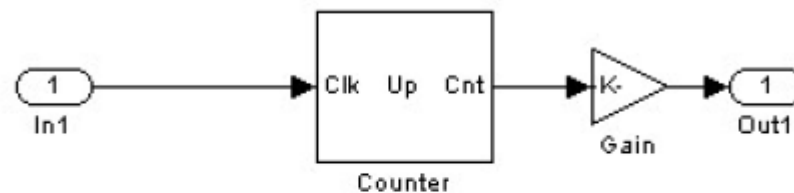


Fig. 8 Block Diagram for varying the variance of the AWGN

The plots of the bit error rate and symbol error rate of the various digital modulation systems vs.  $E_s/N_0$ (dB) are given below:

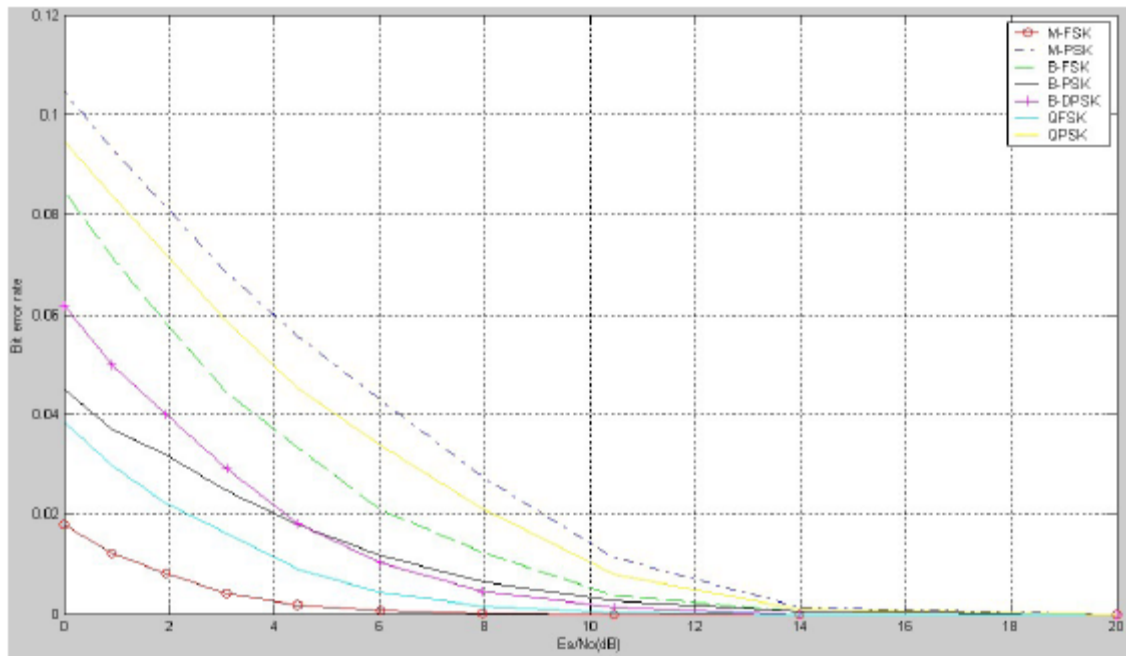


Fig. 9 Bit Error rate vs.  $E_s/N_0$  plot

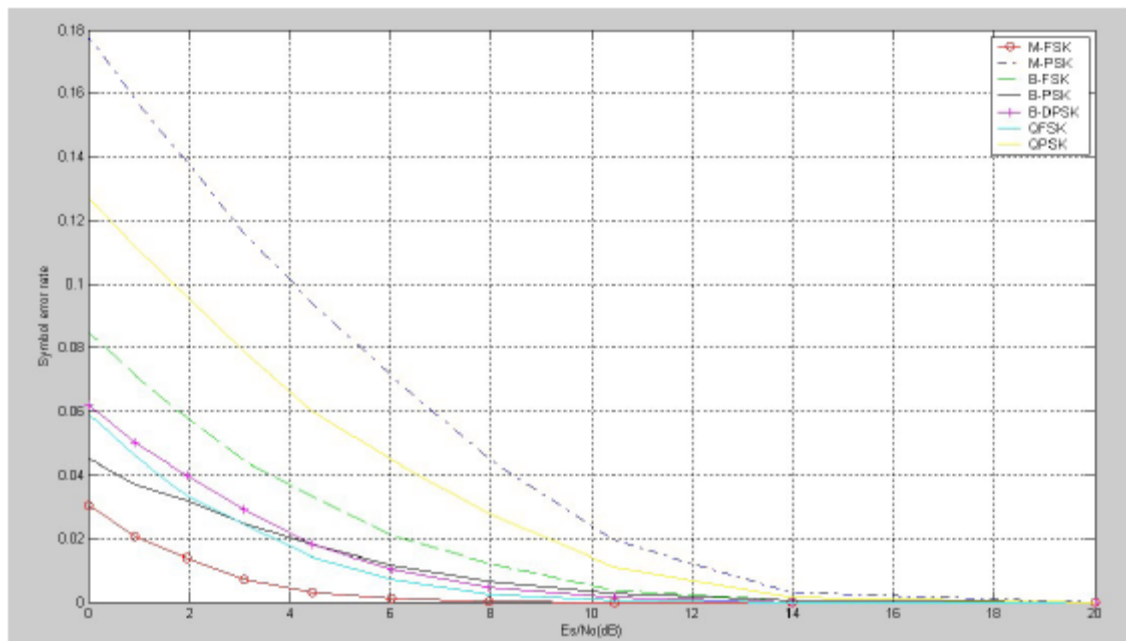


Fig. 10 Symbol Error rate vs.  $E_s/N_0$  plot