Lab 4: BER of BPSK in AWGN Channel

For BPSK modulation, the BER performance is given by

\[ P_b = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) \]  

(1)

**Lab Assignment 1**: you will first compare the simulation BER curve with the theoretic curve given by (1) for BPSK or QPSK modulation.

You can refer to Fig 1. for flow diagram.

![Figure 1: Procedure diagram for Part 1.](image)

**Lab Assignment 2**: you need to use the data from lab0, assuming 3-bit quantization, generate PCM pulses, and transmit over AWGN channel using BPSK. At the receiver side, after hard decision, recover the PCM signal to the analog signal. Finally you can hear the noise corrupted voice quality degradation by decreasing \( E_b/N_0 \).

The main functions used in this lab include:

1. Q function - \( Q(x) \): matlab provides error functions like \( \text{erf}(x) \), \( \text{erfc}(x) \). Please use help to write \( Q(x) \) from \( \text{erf}(x) \) or \( \text{erfc}(x) \).

2. Gaussian random variable generation: you can use

\[ x = \text{randn}(m, n) \]
to generate an array of Gaussian random variables with mean zero and unit variance. Then you can use

\[ y = \sigma \cdot x + m \]  \hspace{1cm} (2)

to obtain Gaussian random variables with mean \( m \) and variance \( \sigma^2 \). You need to consider how to select \( \sigma \) value for given SNR.

3. When you plot your BER curve, use

\[
\text{semilogy}(x, y)
\]

to make y-axis appear in log-scale.