1. **(SNR).** Suppose a sampled audio signal \( x[n] \) is a wide-sense stationary process with zero mean. Don’t worry if you don’t know what a wide-sense stationary process is. Its variance (power) is \( \sigma^2 = 1 \). The values of \( x[n] \) is in the range \([-2, 2]\). Suppose one uses \( N \) bits for quantization. Determine the minimum value of \( N \) so that the SNR of the quantized audio signal is at least 33dB.

2. **(Entropy).** Given an alphabet \( \mathcal{A} = \{a_1, a_2, a_3, a_4\} \), find the entropy in the following cases:
   
   (a) \( P(a_1) = P(a_2) = P(a_3) = P(a_4) = 0.25 \)
   
   (b) \( P(a_1) = 0.5, P(a_2) = 0.25, P(a_3) = P(a_4) = 0.125 \)

3. **(Symbol Codes).** Determine whether the following codes are uniquely decodable

   (a) \{0, 01, 11, 111\}

   (b) \{0, 01, 110, 111\}

   (c) \{0, 10, 110, 111\}

   (d) \{1, 10, 110, 111\}

4. **(Run Length Encoding).** Find the coded sequence using RLE of the following binary sequence:

   \[
   000000100100010010010011000000000
   \]

   What is the corresponding compression ratio?

5. **(Huffman Code).** A source emits letters from an alphabet \( \mathcal{A} = \{a_1, a_2, a_3, a_4, a_5\} \) with probabilities \( P(a_1) = 0.15, P(a_2) = 0.04, P(a_3) = 0.26, P(a_4) = 0.05, \) and \( P(a_5) = 0.5 \).

   (a) Calculate the entropy of this source

   (b) Find a Huffman code for this source

   (c) Find the average length of the code in (b). What is the compression ratio of using Huffman code and the fix-length code of 3 bits to represent the source?