KFUPM-EE DEPT.
EE430: Information Theory and Coding
Problem Set # 4

1. Golay code (23,12) is a perfect code. Determine the error correction capability of the code.

2. Confirm the possibility of an (18,7) code that can correct up to three errors.

3. Consider a (7,4) Hamming code with the parity check matrix H given by:

$$\mathbf{H} = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

   a) Construct the **G** matrix.
   b) Find the codeword for the information sequence [1 1 0 0].
   c) If the word [0101100] is received, what is the decoded codeword?
   d) What action will the decoder take for the following scenarios of error patterns:
      i) two errors in the first and second positions.
      ii) three errors in the first, fourth and seventh positions.
      iii) four errors in the first, fifth, sixth and seventh positions.

4. For a (6,3) systematic linear block code, the three parity-check bits b_0, b_1, and b_2 are given by:

$$b_0 = m_0 \oplus m_1 \oplus m_2$$
$$b_1 = m_0 \oplus m_1$$
$$b_2 = m_0 \oplus m_2$$

   a) Construct the appropriate generator matrix **G**.
   b) Construct the code generated by this matrix.
   c) Determine the error correcting capabilities of this code.
   d) Prepare a suitable decoding table.
   e) Decode the following received codewords: 101100, 000110, 101010.

5. Consider a generator matrix for a nonsystematic (6,3) code:

$$\mathbf{G} = \begin{bmatrix} 0 & 1 & 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

   a) Construct the code for this **G**.
   b) Find the minimum distance and therefore the error correcting capability of the code.
   c) Prepare a code table for this code.
   d) Prepare a suitable decoding table.

From the textbook by *Richard B. Wells*:**4.1.1 ,4.1.6 , 4.1.7, 4.1.8, 4.3.1, 4.3.2, 4.4.2.**

Note: *answers will not be posted. If you have any question you may visit in the office hours or by an appointment***.**

Listen to your own good advice!. **Best regards, Dr. Ali Muqaibel**