

Information and Coding Theory

ENEE 5304

Problem Set 4

Linear Block Codes

1. Consider the (7, 4) linear block code with a generator matrix G:

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

- Find the codeword corresponding to the message (1011)
  - Find the parity check matrix  $H^T$  such that  $GH^T = 0$
  - Construct the Syndrome table for error correction
  - Can you identify and correct the error in the received sequence (0001101)
2. Is it possible to design a (15, 11) single error correcting code? Verify using the Hamming bound.
3. Consider the (5, 1) repetition code
- Find the minimum distance of the code
  - How many errors can this code detect?
  - How many errors can this code correct
  - If the bit error probability is p, find the error probability when this code is employed.
4. Consider the (6, 3) linear block code with the generating matrix

$$G = \begin{bmatrix} 100110 \\ 010011 \\ 001101 \end{bmatrix}$$

- Find all codewords of the code
  - Find the minimum distance of the code
  - Find the error correcting capability of the code
  - Find the codewords corresponding to the messages (001), (010) and (100).
5. Find the error correcting capability of the linear block code (23, 12).