Practice questions

Introduction to Coding Theory(CSE2032)

1. Let C be a binary $(7, 3)$ code with generator matrix

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

   (a) Reduce G to standard form.

   (b) Find Parity check matrix for C.

   (c) Write out the element of dual code $C^{\perp}$.

2. Consider binary $(4, 2)$ code C with generator matrix

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

   (a) Find the parity check matrix Find the cosets and coset leader.

   (b) Find the cosets, coset leader and their syndrome

3. Let C be a binary $(7, 4)$ code with parity check matrix

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

   (a) Find coset leaders and their syndromes.

   (b) Use syndrome decoding to decode the following received codewords.

      i. 11100011

      ii. 11111111

4. Find the generator matrix for $(7, 3)$ cyclic code ove $GF(2)$. List the codewords.

5. Find the parity check polynomial and the corresponding H matrix for the cyclic code over $GF(2)$ with block length $n = 7$ and $g(x) = (x^3 + x + 1)$

6. Consider the generator polynomial $g(x) = (x^3 + x + 1)$ for $(7, 3)$ cyclic code over $GF(2)$. Let the received vector $r(x) = (1 + x + x^3 + x^4 + x^6)$.

   (a) Calculate the syndrome polynomial for $r(x)$.

   (b) Find all the cyclic shifts of $r(x)$ and calculate the syndrome for each polynomial.

7. Consider a Cyclic Redundancy Check(CRC) code with generator polynomial $g(x) = x^{16} + x^{15} + x^2 + 1$. Let the message polynomial be $m(x) = x^{14} + x^{12} + x^{10} + x^9 + x^8 + x^5 + x^2 + x + 1$. Find the corresponding codeword polynomial $C(x)$. [6]

8. Consider $(7, 4)$ cyclic code with generator polynomial $g(x) = 1 + x + x^3$. The message to be encode is $m(x) = 1 + x^3$. Find the code polynomial and the corresponding code vector.

****END***