UNIT3

QUIZ3[CO3]

1. The number of Parity check bits in an (n, k) Linear Block codes are (***b***) **2M**.
   a. n   b. (n-k)   c. (n+k)   d. k
2. The Hamming Weight of the following code words 10011101 & 00111100 is (***c***) **2M.**
   a. None of these   b. 4, 5   c.5, 4   d.3,4
3. A cyclic code can be generated using------------------------ and A block can be generated using-------------------.(***c***) **2M.**
   a. Generator matrix & Generator polynomial.
   b. Generator matrix & Generator matrix.
   c. Generator polynomial & Generator matrix.
   d. None of the above.
4. The rate of a Block code is the ratio of(***c***) **2M.**
   a. Message length to Block length.
   b. Block length to message length.
   c. Message weight to Block length.
   d. None of the mentioned.
5. The syndrome in LBC is calculated using , where Y represents received code word (***a***) **2M**.
   a. $S= Y H^T$ b. $S = YH$ c. $S= Y^T H$ D. $S= Y^T H^T$
6. A non-Zero value of Syndrome in a Block code represents (***b***) **2M**.
   a. No error during transmission.
   b. An error occurred during transmission.
   c. Both a and b.
   d. None of the above.
7. The transmitted codeword(X) in an LBC can be obtained from received code word(Y) by using the equation (***a***), where E represents error vector. **2M.**
   a. X= E + Y   b. X = X.Y   c. X= E.Y   d. X= X/Y
8. The parity check matrix of a (6,3) block code if Generator matrix is G **3M.**

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

Ans. Parity check matrix is H

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

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9. In the above question find the code words corresponding to message vectors [110] and [111] ---. **3M.**

Ans. X = m G

For the message vector m= 110, the encoded code word X_1 is

$$X_1 = m_1 G \text{---------}\rightarrow [1\ 1\ 0]\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

The matrix multiplication yields to X_1 = [1 1 0 1 1 0]

For the message vector m= 110, the encoded code word X_1 is

$$X_2 = m_2 G \text{---------}\rightarrow [1\ 1\ 1]\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

The matrix multiplication yields to X_2 = [1 1 1 0 0 0]

Hint: after multiplication perform XOR operation.

10. For the Q.8. Find the syndrome value when the received code word is 001111----**4M**.

Ans. Syndrome is calculated by using the equation S = Y H^T, where Y is received vector

$$S = [0\ 0\ 1\ 1\ 1\ 1]\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

= [0 0 1]

11. For a (7,4) cyclic code , the generator polynomial is given as $g(x) = 1 + x + x^3$ find the codeword for the data 1100 **6M.**
Non systematic codeword is--------------------------.
Systematic codeword is-------------------------------.

Ans. For the data 1100 the data polynomial is $D(x) = (1 + x)$
Non systematic code word is V(x) = D(x) g(x)

$$= (1 + x)(1 + x + x^3)$$

$$= (1 + x + x^3 + x + x^2 + x^4)$$

By performing XOR operation $(1 + x^2 + x^3 + x^4)$

∴ The Non systematic Code Word is 1 0 1 1 1 0 0

To get Systematic code word

Multiply D(x) with x^{n-k}
i.e, $x^3(1+x) \;=\; (x^4+x^3)$

now, divide the resultant polynomial with g(x)

$$x^3+x+1)\; x^4+x^3\; (\; x+1$$
$$x^4+x^2+x$$

$$x^3+x^2+x$$
$$x^3+x+1$$

$$x^2+1$$

Now the remainder polynomial is $r(x) = 1+x^2$, As we know the number of parity check bits are (n-k) in an (n,k) cyclic code

The number of bits in Remainder are again (n-k)

Therefore from the polynomial r(x) the parity check bits are 1 0 1

Now the systematic codeword is parity check bits appended to the data bits

i.e, 1 0 1 1 1 0 0

the first 3 bits are parity check bits and the next 4 bits are data bits 1100.