LAB REPORT - 7

CYCLIC BLOCK ENCODING USING MATLAB

THEORY:

Cyclic codes are known to be a crucial subcategory of linear coding technique because these offers efficient encoding and decoding schemes using a shift register. These are used in error correction as they can checkfor double or burst errors. Various other important codes like, Reed Solomon, Golay, Hamming, BCH, etc. can be represented using cyclic codes.

We have discussed in linear block codes as well that a linear codeword isgenerally given as c(n,k). Here n represents the total bits in the codeword,and k denotes the message bits. Thus, the parity bits are (n-k). Suppose we are given a code (7,4) then on comparing with general format the codeword will have 7 bits and the actual message bits are 4 while rest 3 are parity bits.

A cyclic codeword is given as:

$$C = [C_1, C_2, C_3 - - - - - C_{n-1}]$$

Then the codeword polynomial will be represented as:

$$C(X) = C_0 + C_1X + C_2X^2 + - - - - - + C_{n-1}X^{n-1}$$

In a similar way, for any message codeword m, the message polynomial

$$M(X) = m_0 + m_1X + m_2X^2 + - - - - - + m_{k-1}X^{k-1}$$

And generator polynomial

$$G(X) = g_0 + g_1X + g_2X^2 + - - - - - + g_{n-k}X^{n-k}$$

Codewords are classified as systematic and non-systematic codewords.
A systematic codeword is one in which the parity bits and message bits arepresent in separate forms.
C = [parity bit, message bits]
But a non-systematic codeword is the one in which the message and paritybits exist in

intermixed format and cannot be separated just by noticing the initial and final bits.

ENCODING:

Non-Systematic Cyclic Encoding:
With message polynomial
$m(x) = m0 + m1x + \cdots + mk-1xk-1$
and generator polynomial $g(x)$, the codeword polynomial is
$c(x) = m(x)g(x) = m0g(x) + m1xg(x) + \cdots + mk-1xk-1g(x)$

Systematic Cyclic Encoding:
The equation for determining codeword for systematic code is given as:

$$C(X) = X^{n-k} M(X) + P(X)$$

P(X) represents the parity polynomial and is given by:

$$P(X) = \text{Remainder of } \{\frac{X^{n-k}M(X)}{G(X)}\}$$

So, to construct the systematic codeword first we must determine P(X).

CODE:

```
clc;

clear all;

close all;

n=input('Enter codeword length');

k=input('Enter No of msg bits');

G=input('Enter Generator Polynomial');

msg=dec2bin(0:2^k-1); %Generating all the Message Bits

[i,px]=cyclgen(n,G); %Converting Generator Polynomial to Generator Matrix

g=circshift(px,[0,k]); %Circular Shifting the matrix to get correct

%generator Matrix

disp("Message Bits");

disp(msg);

disp("Generator Matrix");

disp(g);
```

```
c=rem(msg*g,2);

disp("CodeWords")

disp(c);
```

OUTPUT:

Command Window

```
Enter codeword length7
Enter No of msg bits4
Enter Generator Polynomial[1 1 0 1]
Message Bits
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111
Generator Matrix
     1     0     0     0     1     1     0
     0     1     0     0     0     1     1
     0     0     1     0     1     1     1
     0     0     0     1     1     0     1
```

```
CodeWords
     0     0     0     0     0     0     0
     0     0     0     1     1     0     1
     0     0     1     0     1     1     1
     0     0     1     1     0     1     0
     0     1     0     0     0     1     1
     0     1     0     1     1     1     0
     0     1     1     0     1     0     0
     0     1     1     1     0     0     1
     1     0     0     0     1     1     0
     1     0     0     1     0     1     1
     1     0     1     0     0     0     1
     1     0     1     1     1     0     0
     1     1     0     0     1     0     1
     1     1     0     1     0     0     0
     1     1     1     0     0     1     0
     1     1     1     1     1     1     1
```

CONCLUSION:

Cyclic block encoding is performed using in-built functions in Matlab.