Assignment — 04

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Section : 13

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Block Coding

Ans. to the Q. NO - 01

Haming distance,

(00, 01) = 7

(00, 10) = 3

(00, 11) = 6

(01, 10) = 6

(01, 11) = 3

(10, 11) = 7

$\therefore d_{min} = 3$

$\therefore$ detection = $d_{min} = s + 1$

$\Rightarrow 3 = s + 1$

$\Rightarrow s = 3 - 1 = 2$

$\therefore$ error detection = 2 (Ans:)

$d_{min} = 2t + 1 \Rightarrow$ (connection)

$\Rightarrow 3 = 2t + 1$

$2t = 2$

$t = 1$

$\therefore$ error correction = 1

(Ans:)

```
 1 1 1 0 0 0 0 0
⊕0 0 0 1 1 1 0 1
---------------
 1 1 1 1 1 0 1
           (00,10)

 1 1 1 0 0 0 0 0
⊕1 0 1 0 1 0 1 0
---------------
 0 1 0 0 1 0 1 0
           (00,10)

 1 1 1 0 0 0 0 0
⊕0 1 0 1 0 1 1 1
---------------
 1 0 1 1 0 1 1 1
           (00,11)

 0 0 0 1 1 1 0 1
⊕1 0 1 0 1 0 1 0
---------------
 1 0 1 1 0 1 1 1
           (01,10)

 0 0 0 1 1 1 0 1
⊕0 1 0 1 0 1 1 1
---------------
 0 1 0 0 1 0 1 0
           (01,11)

 1 0 1 0 1 0 1 0
⊕0 1 0 1 0 1 1 1
---------------
 1 1 1 1 1 1 0 1
           (10,11)
```

Ans. to the Q. NO- 02

Haming distance here,

(00,01) = 7

(00,10) = 3

(00, 11) = 4

(01, 10) = 6

(01, 11) = 5

(10, 11) = 5

here,

$d_{min} = 3$

$\therefore$ detection = $d_{min} = s+1$

$\Rightarrow 3 = s+1$

$\therefore s = 3-1 = 2$

$\therefore$ error detection = 2 (Ans:)

again,

correction = $d_{min} = 2t+1$

$\Rightarrow 3 = 2t+1$

$\Rightarrow 2t = 2$

$\Rightarrow t = 1$

$\therefore$ error correction = 1

```
11110000
⊕ 00001101
-----------
  11111101
          (00,01)

11110000
10111010
⊕
-----------
01001010
        (00,10)

11110000
⊕ 01110111
-----------
10001111
        (00,11)

0000 1101
10111010
⊕
-----------
1011 0111
        (01,10)

0000 1101
⊕ 0111 0111
-----------
0111 0101
        (01,11)

10 111 010
⊕ 0 1110 111
-----------
1100 1101
        (10,11)
```

[P.T.O.]

Now,

given codeword = 10101010

for dataword '10' : codeword = 10111010

∴ haming distance =

```
  10101010
  10111010
----------
  00010000
```

∴ here, error detection = 1

∴ we can correct this error here.

∴ for given code word,

the dataword will be 10.

(Ans:)

CRC

Ans. to the Q. NO-01

Given message,

1011101000

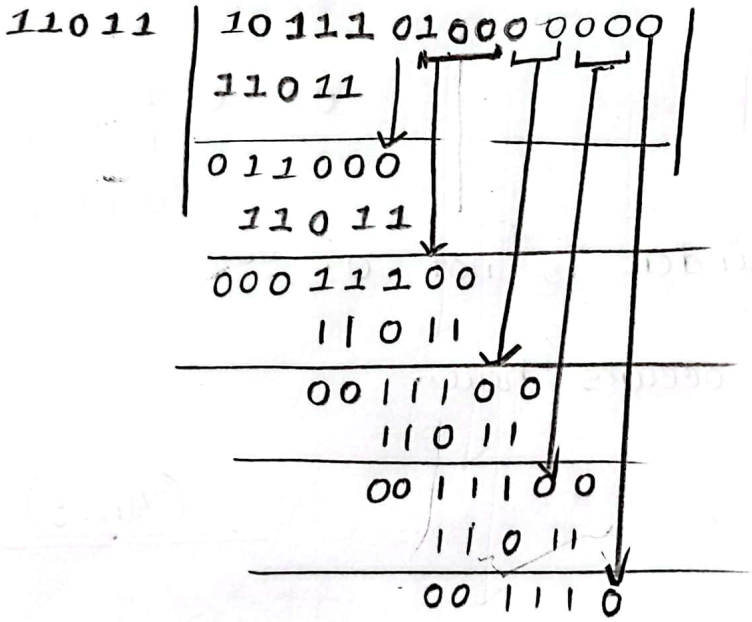
CRC generator polynomial = 1011

Now,

adding 0's = 1011101000 0000

[∵ divisor = 5 bit
∴ 0's to add = 5-1
= 4 bit]

Here,



∴ remainder = ~~00~~ 1110.

transmitted message = 1011101000 0000

corrupted message = 1011 0101 0 111 0

P. [T. O.]

Now,

~~1101 | 10111010101110~~

corrupting 6 bit = 10 1110 1010 1110

∴

```
11011 | 10 1110 1010 1110 |
        11 011
        -------
        01 1000
           11011
           -----
           00 0110
              11011
              -----
              00 1100
                 11011
                 -----
                 00 0101 10
                    11011
                    -----
                    00 0110
                       11011
                       -----
                       00 1101
```

∵ remainder is not 0.

∴ error occurs here.

(Ans:)

Answer to the Q. NO- 02

Given,

message = $x^8 + x^7 + x^5 + x^4 + x + 1$

divisor = $x^4 + 1$

Here,

multiplying the given message with x^4,

$= x^{12} + x^{11} + x^9 + x^8 + x^5 + x^4$

$\therefore$

$$
\begin{array}{r|l}
x^4+1 & x^{12}+x^{11}+x^9+x^8+x^5+x^4 \;\big|\; x^8+x^7+x^5+x^3+1 \\
\hline
 & x^{12}+x^8 \\
\hline
 & x^{11}+x^9+x^5+x^4 \\
 & x^{11}+x^7 \\
\hline
 & x^9+x^7+x^5+x^4 \\
 & x^9+x^5 \\
\hline
 & x^7+x^4 \\
 & x^7+x^3 \\
\hline
 & x^4+x^3 \\
 & x^4+1 \\
\hline
 & x^3+1
\end{array}
$$

$\therefore$ remainder = $x^3 + 1$

transmitted message = $x^{12} + x^{11} + x^9 + x^8 + x^5 + x^4 + x^3 + 1$

Now,

corrupting right most 5th bit

$= x^{12} + x^{11} + x^9 + x^8 + x^5 + x^3 + 1$

[P. T. O.]

Now,

$$x^4+1 \;\Big|\; x^{12}+x^{11}+x^9+x^8+x^5+x^3+1 \;\Big|\; x^8+x^7+x^5+x^3$$

$x^{12}+x^8$

$x^{11}+x^9+x^5+x^3+1$

$x^{11}+x^7$

$x^9+x^7+x^5+x^3+1$

x^9+x^5

x^7+x^3+1

x^7+x^3

1

∵ remainder is not 0.

∴ error occurs here.

(Ans:)

Ans. to the Q. NO - 03

Given,

dataword = 10011 0

Remainder = 100

transmitted message = 100 110100

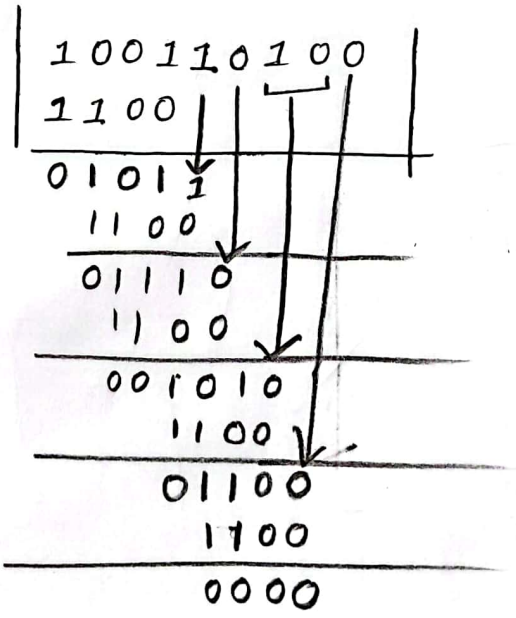
∵ Remainder = 3 bit

∴ To add 0's,

divisor = 3+1 = 4 [∵ Where first 2 bits are 1, rest are 0]

∴ divisor = 1100

Now,



Here,

∵ remainder = 0

∴ This given codeword has no errors. (Ans:)