HW-3

Monday, February 26, 2024 21:16

Q2. a)

$P(x) = x^4 + x + 1$

$= 10011 = 5$ bit

$D(x) = 1001001101 1 = x^{10} + x^7 + x^4 + x^3 + x + 1$

EXTRA bit to be added $= 5 - 1 = 4$

$D' = 1001001101 1 0000$

$D'(x) = x^{14} + x^{11} + x^8 + x^7 + x^5 + x^4$

To Encode

$x^4 + x + 1 \;\big)\; x^{14} + x^{11} + x^8 + x^7 + x^5 + x^4 \;\big(\; x^{10} + x^8 + x^7 + x^6 + x^4 + x^2 \leftarrow Q(x)$

$x^{14} + x^{11} + x^{10}$

$x^{10} + x^8 + x^7$

$x^{10} + x^8 + x^7 + x^6$

$x^8 + x^6 + x^5 + x^4$

$x^8 + x^6 + x^5 + x^4$

$x^6 + x^5 + x^4 + x^2$

$x^6 + x^5 + x^4 + x^2$

$x^5 + x^4 + x^3 + x^2$

$R(x) \rightarrow x^3 + x^2$

$x^4 D(x)$

Transmitted $(x) = x^{14} + x^{11} + x^8 + x^7 + x^5 + x^4 + x^3 + x^2$

Encoded bits = 1001001101 1100

Q2. b)

Error Pattern = 1000100000000000

Transmitted bits = 1001001101 1100
(To be filtered from 9)

Filtered Data = 0001101101 1100
(Flip 1 to 0 / 0 to 1)

Received Data

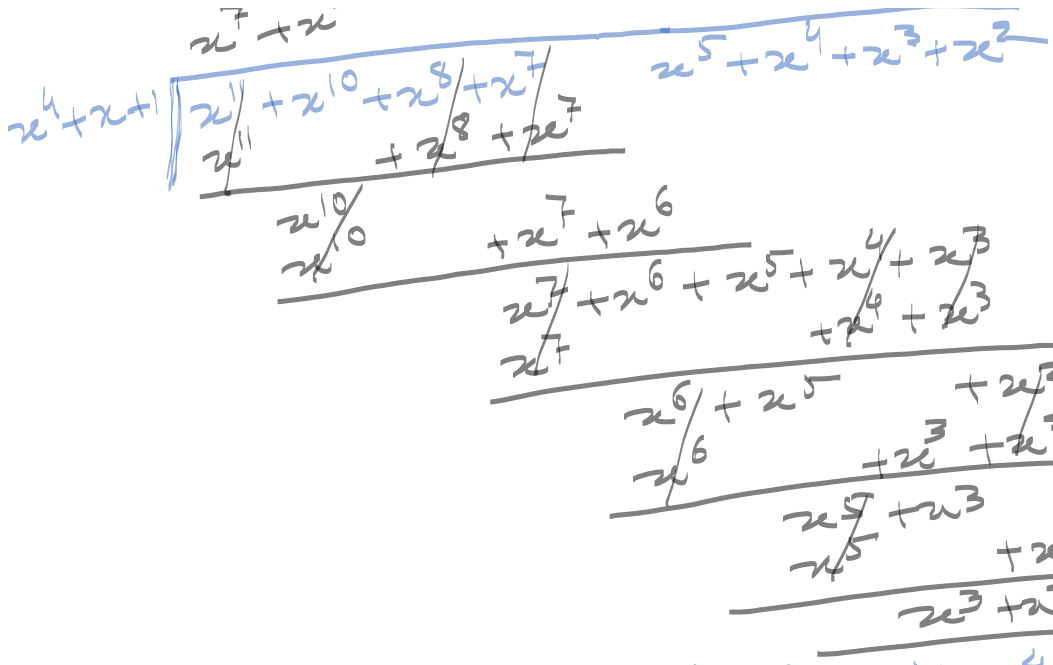
$P(x) = x^4 + x + 1 = 10011 =$ Divided by

To detect error

$D(x) = 0001101101 1100 = x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^3 + x^2$

$x^7 + x^6 + x^3 + x^2 + x$

$x^{11} + x^{10} + x^8 + x^7 \;\big)\; x^5 + x^4 + x^3 + x^2$



Dividend (Polynomial) = $x^{11}+x^{10}+x^8+x^7+x^5+x^4+x^3+x^2$

Divided by = x^4+x+1

Quotient = $x^7+x^6+x^3+x^2+x$

Remainder = $x^3+x^2+x = 1110$

As we see, the Remainder after division is x^3+x^2+x (1110), which is non zero. The errors are detected.

Q.2 (c)

ERROR Pattern = 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0

To be Filtered Data = 1 0 0 1 0 0 1 1 0 1 1 1 1 0 0

Filtered Data (Flip at position 1, 4, 5) = 0 0 0 0 1 0 1 1 0 1 1 1 1 0 0

14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

Hence form, Received Data = 0 0 0 0 1 0 1 1 0 1 1 1 1 0 0

$D(x) = x^{10}+x^8+x^7+x^5+x^4+x^3+x^2$

$P(x) = x^4+x+1$

To detect errors,

$x^6+x^4+x^2+1$

To detect

$$x^4 + x + 1 \;\overline{)\; x^{10} + x^8 + x^7 + x^5 + x^4 + x^3 + x^2}$$

$x^{10} + x^7 + x^6$ → $x^6 + x^4 + x^2 + 1$

$x^8 + x^6 + x^5 + x^4$ → $x^8 + x^5 + x^4$

$x^6 + x^3 + x^2$ → $x^6 + x^3 + x^2$

$0 \quad 0 \quad 0$

Remainder = 0 0 0 0

conclusion:

The string 0 0 0 0 1 0 1 1 0 1 1 1 1 0 0 is received, corresponding to $x^{10} + x^8 + x^7 + x^5 + x^4 + x^3 + x^2$. The Remainder after division by $x^4 + x + 1$ is 0 0 0 0, which is zero.

Hence, ERROR not detected.