Serial #

0

- 1 points for not writing your serial number

King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE430: Information Theory and Coding (072)
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Quiz 4: Cyclic Codes

Name: KEY

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1) Perform the following operation in GF(2): $x + x^4 \bmod (x^2+1)$

or $x + x^4 \big|_{x^2 = 1} = x + (x^2)^2 = x + 1$ ✓

$$\begin{array}{r} x^2+1 \\ 1+x^2 \overline{\smash{\big)}\, x + x^4} \\ \underline{x^2 + x^4} \\ x^2 + x \\ \underline{x^2 + 1} \\ x+1 \end{array}$$

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2) Simplify in GF(2): $(1+x^n)^2$

$(1+x^n)(1+x^n) = 1 + (1+1)x^n + x^{2n}$
$= 1 + x^{2n}$

3) Is the following valid generator polynomial $x + x^2$, why?

No, because $g_0 \neq 1$

4) Given that $x^7 + 1 = (1+x)(1+x+x^3)(1+x^2+x^3)$

5 4

a. List all the valid code-words for the (7,5) cyclic code 1.5

b. List all the valid code-words for the (7,3) systematic cyclic code generated by $g(x) = (1+x)(1+x+x^3)$ 3.5

a) $(7,5) \Rightarrow r = 2$. It is not possible to find a polynomial of degree 2 which is a factor of x^7+1

we can get $(7,6)$, $(7,3)$, $(7,3)$, $(7,4)$, $(7,4)$, $(7,1)$

b) For systematic codes. $c(x) = b_0 b_1 b_2 b_3 m_0 m_1 m_2$

$b(x) = \text{rem}\left[\dfrac{x^r m(x)}{g(x)}\right] = \text{rem}\left[\dfrac{x^4 m(x)}{(1+x)(1+x+x^3)}\right]$

$(1+x)(1+x+x^3) = 1 + \cancel{x} + x^3 + \cancel{x} + x^2 + x^4 = 1 + x^2 + x^3 + x^4$

for $000 \Rightarrow m(x) = 0 \Rightarrow C(x) = 0000\ 000$

for $100 \Rightarrow m(x) = 1$

$b(x) = \text{rem}\left[\dfrac{x^4}{1+x^2+x^3+x^4}\right] = 1 + x^2 + x^3 \Rightarrow C(x) =$

0 0 0 0	0 0 0
1 0 1 1	1 0 0
0 1 0 1	1 1 0
0 0 1 0	1 1 1
1 0 0 1	0 1 1
1 1 0 0	1 0 1
1 1 1 0	0 1 0
0 1 1 1	0 0 1

with 7 cyclic shifts we generate all the 8 code words.

Note that these are all the possible

"*It is better to do the right problem the wrong way than the wrong problem the right way*"- *Richard Hamming*