

Homework Number: hw04

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Due Date: Tuesday 2/18/2020 at 4:29PM

## 1. Theory Problems

I. Determine the following in GF(11), please show your work:

i.  $(3x^4 + 5x^2 + 10) - (8x^4 + 5x^2 + 2x + 1)$   
 $= -5x^4 - 2x - 9$

ii.  $(5x^2 + 2x + 7) \times (5x^3 + 3x^2 + 3x + 2)$   
 $= 25x^5 + 15x^4 + 15x^3 + 10x^2 + 10x^4 + 6x^3 + 6x^2 + 4x + 35x^3 + 21x^2 + 21x + 14$   
 $= 25x^5 + 25x^4 + 56x^3 + 37x^2 + 25x + 14$   
 $= 3x^5 + 3x^4 + x^3 + 4x^2 + 3x + 3$

iii.  $\frac{x^5 + 8x^4 + x^3 + 4x^2 + 8x}{6x^3 + 3x^2 + 2}$

$$1/6 = 1 \times 6^{-1} = 1 \times 2 = 2 \pmod{11} = 2$$

Product of  $2x^2$  and  $6x^3 + 3x^2 + 2$  is  $x^5 + 6x^4 + 4x^2$ , subtract it from the dividend  $x^5 + 8x^4 + x^3 + 4x^2 + 8x$ , result is  $2x^4 + x^3 + 8x$ .

$$2/6 = 2 \times 6^{-1} = 2 \times 2 = 4 \pmod{11} = 4$$

Product of  $4x$  and  $6x^3 + 3x^2 + 2$  is  $2x^4 + x^3 + 8x$ , subtract it from the dividend  $2x^4 + x^3 + 8x$ , result is 0.

$$\text{Therefore, } \frac{x^5 + 8x^4 + x^3 + 4x^2 + 8x}{6x^3 + 3x^2 + 2} = 2x^2 + 4x$$

II. For the finite field GF( $2^3$ ), calculate the following for the modulus polynomial  $x^3 + x^2 + 1$

i.  $(x^2 + x + 1) \times (x + 1)$   
 $= (x^2 + x + 1) \times (x + 1) \pmod{x^3 + x^2 + 1}$   
 $= (x^3 + 2x^2 + 2x + 1) \pmod{x^3 + x^2 + 1}$   
 $= x^2 + 2x$

ii.  $(x^2 + 1) - (x^2 + x + 1)$   
 $= -x \pmod{x^3 + x^2 + 1} = x$

iii.  $\frac{x^2 + x + 1}{x^2 + 1} = 1 + \frac{x}{x^2 + 1}$

## 2. Programming Problem