

# Código Redundante Cíclico - CRC

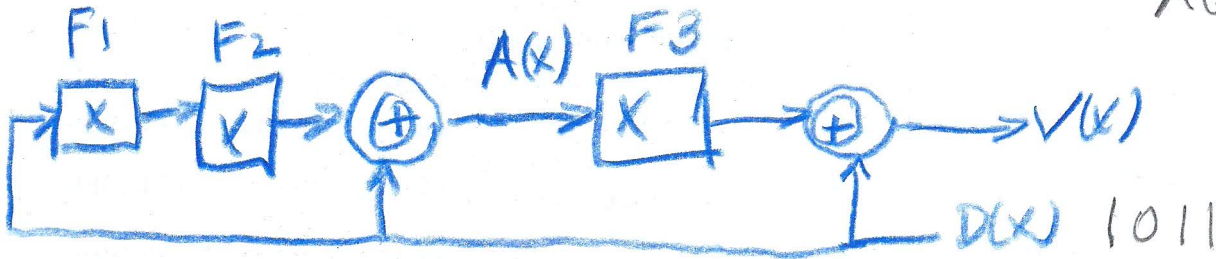
①

## CODIFICAÇÃO

(Não Separáveis)

$$G(x) = 1 + x + x^3$$

$$V(x) = D(x) \cdot G(x) = D(x)(1 + x + x^3) = D(x) + x(D(x) + D(x)x^2) \quad A(x)$$



Clock	D(x)	F1	F2	F3	A(x)	V(x)
0	1	0	0	0	1	1
1	1	1	0	1	1	0
2	0	1	1	1	1	1
3	1	0	1	1	0	0
4	0	1	0	0	0	0
5	0	0	1	0	1	0
6	0	0	0	1	0	1
7	0	0	0	0	0	0

1000101

↓ em polinômio  
 $1 + x^2 + x^6$

# VERIFICAÇÃO

(2)

$$Q(x) = 1 + x + x^3 \quad D(x) = 1 + x + x^3$$

$$(1 + x + x^3)(1 + x + x^3) = 1 + \cancel{x} + \cancel{x^3} + \cancel{x} + \cancel{x^2} + \cancel{x^4} + \cancel{x^3} + \cancel{x^4} + \cancel{x^6}$$

$$= \underline{1 + x^2 + x^6}$$

ou

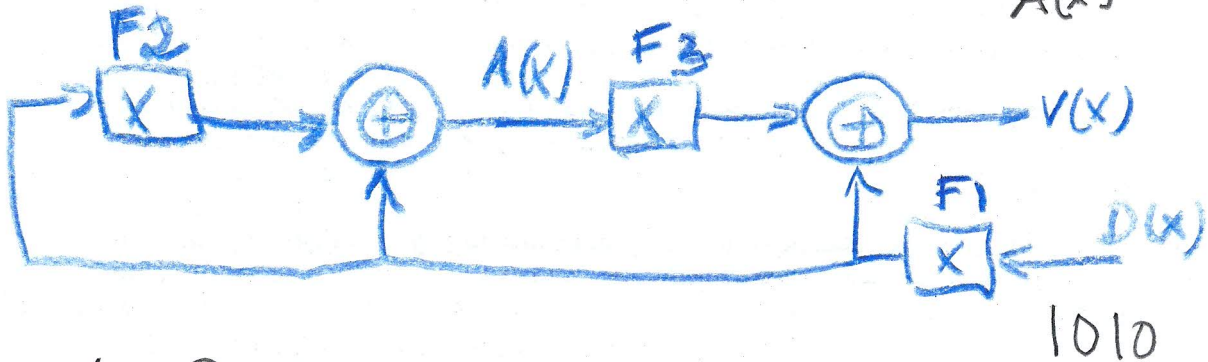
$$\begin{array}{r} 1011 \\ 1011 \\ \hline 1011 \\ 1011 \\ 0000 \\ 1011 \\ \hline \boxed{1000101} \end{array}$$

# Exercício 6

$$G(x) = x + x^2 + x^3$$

$$V(x) = G(x) \cdot D(x) = D(x)(x + x^2 + x^3) = D(x) \cdot x + x(D(x)x + D(x)x^2))$$

$A(x)$



Clock	D(x)	F1	F2	F3	A(x)	V(x)
0	0	0	0	0	0	0
1	1	0	0	0	0	0
2	0	1	0	0	1	1
3	1	0	1	1	1	1
4	0	1	0	1	1	0
5	0	0	1	1	1	1
6	0	0	0	1	0	1
7	0	0	0	0	0	0

1101100

em polinômio

$$\underline{x^2 + x^3 + x^5 + x^6}$$

# VERIFICAÇÃO

(4)

$$G(x) = x + x^2 + x^3 \quad D(x) = x + x^3$$

$$\begin{aligned} (x+x^3)/(x+x^2+x^3) &= x^2 + x^3 + \cancel{x^4} + \cancel{x^4} + x^5 + x^6 \\ &= x^2 + x^3 + x^5 + x^6 \end{aligned}$$

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OU

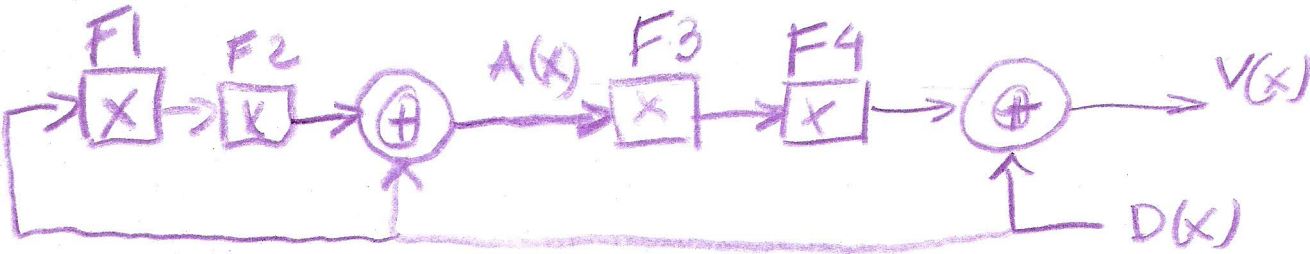
$$\begin{array}{r} 1110 \\ 1010 \\ \hline 0000 \\ 1110 \\ 0000 \\ 1110 \\ \hline 1101100 \end{array}$$

### Exercício 7

(5)

$$G(x) = 1 + x^2 + x^4$$

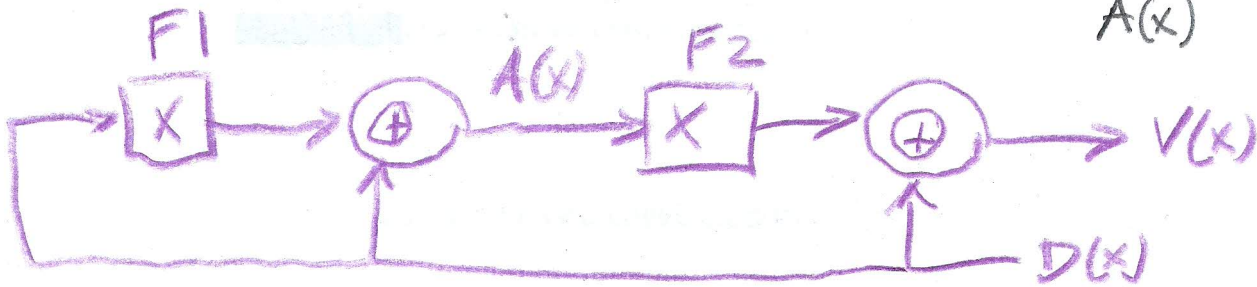
$$V(x) = D(x) \cdot G(x) = D(x)(1 + x^2 + x^4) = D(x) + \underbrace{x^2(D(x) + D(x) \cdot x^2)}_{A(x)}$$



### Exercício 8

$$G(x) = 1 + x + x^2$$

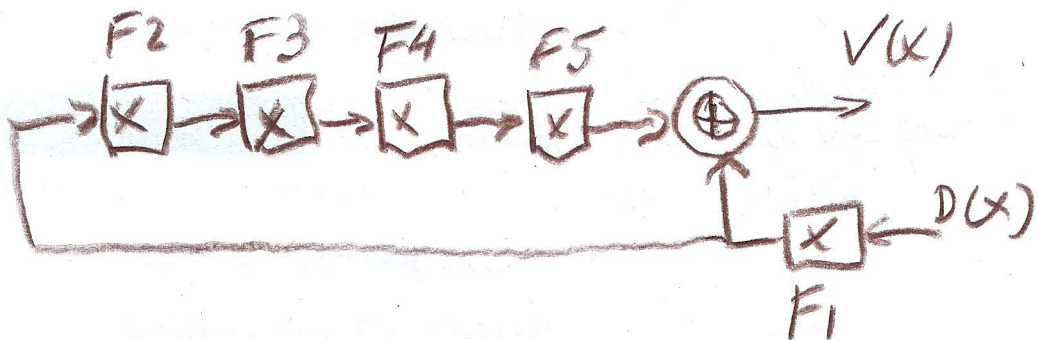
$$V(x) = D(x)G(x) = D(x)(1 + x + x^2) = D(x) + \underbrace{x(D(x) + xD(x))}_{A(x)}$$



### Exercício 9

$$G(x) = x + x^5$$

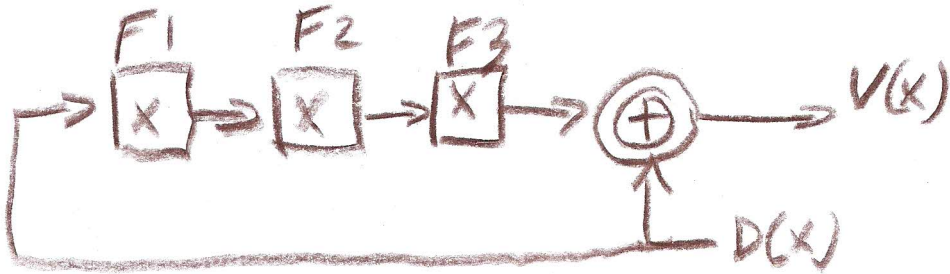
$$V(x) = D(x)G(x) = D(x)(x + x^5) = D(x) \cdot x + D(x) \cdot x^5$$



## Exercício 10

$$G(x) = 1 + x^3$$

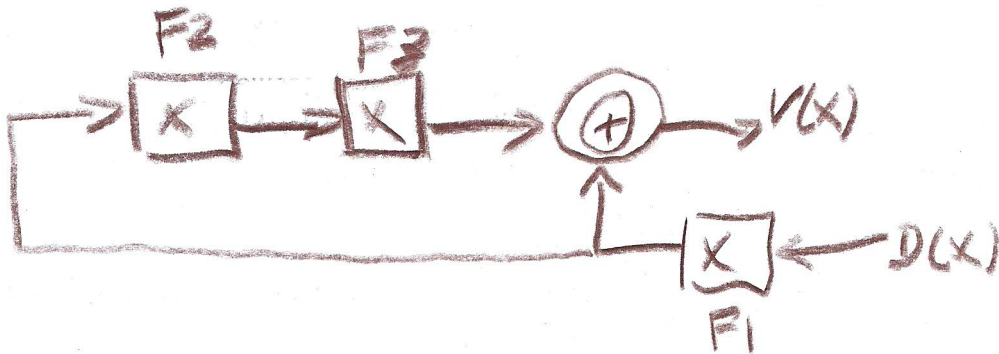
$$V(x) = D(x)G(x) = D(x)(1 + x^3) = D(x) + D(x)x^3$$



## Exercício 11

$$G(x) = x + x^3$$

$$V(x) = D(x)G(x) = D(x)(x + x^3) = D(x)x + D(x)x^3$$



# DECODIFICAÇÃO

(7)

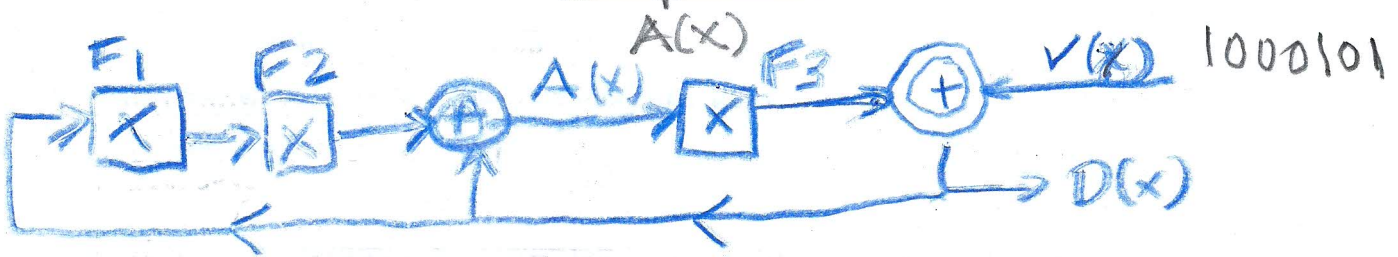
$$G(x) = 1 + x + x^3$$

$$V(x) = D(x) \cdot G(x) = D(x) \cdot (1 + x + x^3)$$

$$V(x) = D(x) + x(D(x)) + D(x) \cdot x^2$$

(modulo 2)

$$D(x) = V(x) + x(D(x)) + D(x) \cdot x^2$$



Clock	V(x)	F1	F2	F3	A(x)	D(x)
0	1	0	0	0	1	1
1	0	1	0	1	1	1
2	1	1	1	1	1	0
3	0	0	1	1	0	1
4	0	1	0	0	0	0
5	0	0	1	0	1	0
6	1	0	0	1	0	0
7	0	0	0	0	0	0

$$\begin{array}{r} \downarrow \\ 1011 \\ \hline \downarrow \\ \underline{1+x+x^3} \end{array}$$

# Exercício 6

$$G(x) = x + x^2 + x^3$$

$$V(x) = G(x) \cdot D(x) = D(x) (x + x^2 + x^3)$$

$$V(x) = D(x) \cdot x + D(x) x^2 + D(x) x^3$$

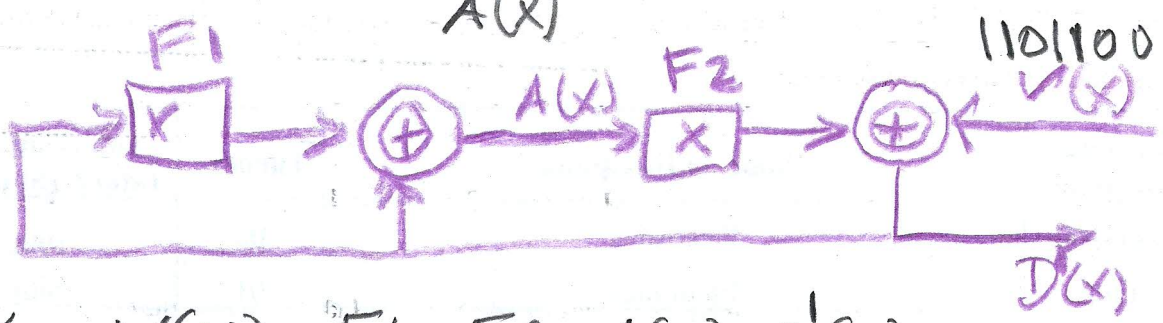
$D'(x)$  → deslocamento para à esquerda

$$V(x) = D'(x) + D'(x)x + D'(x)x^2$$

↙ modulo 2

$$D'(x) = V(x) + x (D'(x) + D'(x)^2)$$

$A(x)$



Clock	V(x)	F1	F2	A(x)	D'(x)
0	0	0	0	0	0
1	0	0	0	0	0
2	1	0	0	1	1
3	1	1	1	1	0
4	0	0	1	1	1
5	1	1	1	1	0
6	1	0	1	0	0
7	0	0	0	0	0

1010

deslocamento para direita

10100



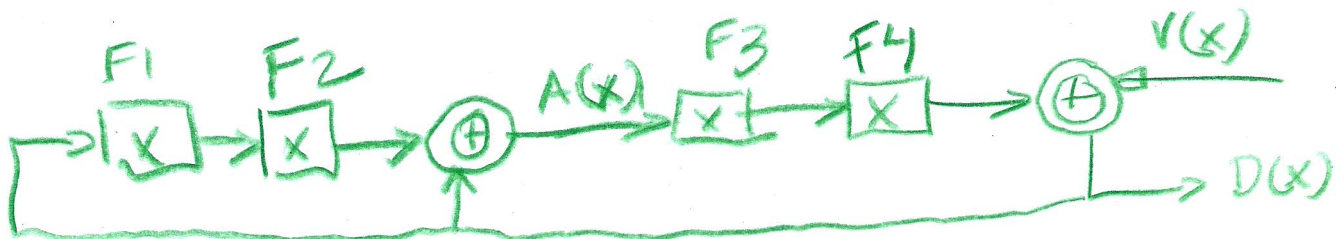
### Exercício 7

(9)

$$G(x) = 1 + x^2 + x^4$$

$$V(x) = D(x) G(x) = D(x) + x^2 (D(x) + D(x) x^2)$$

$$D(x) = V(x) + \underbrace{x^2 (D(x) + D(x) x^2)}_{A(x)}$$

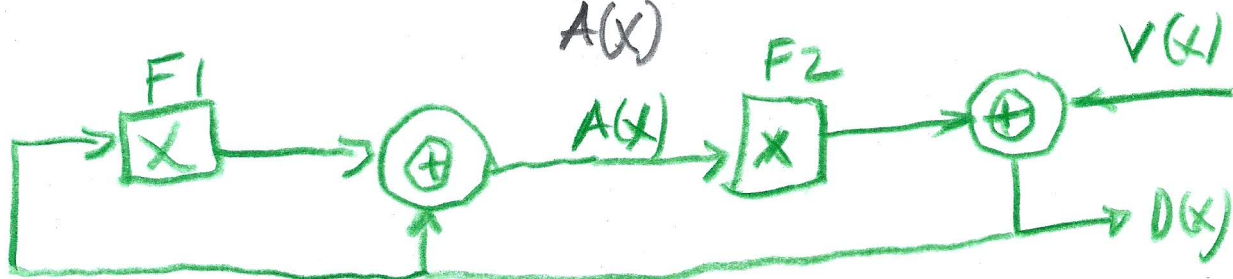


### Exercício 8

$$G(x) = 1 + x + x^2$$

$$V(x) = D(x) G(x) = D(x) (1 + x + x^2)$$

$$D(x) = V(x) + \underbrace{x (D(x) + D(x) \cdot x)}_{A(x)}$$



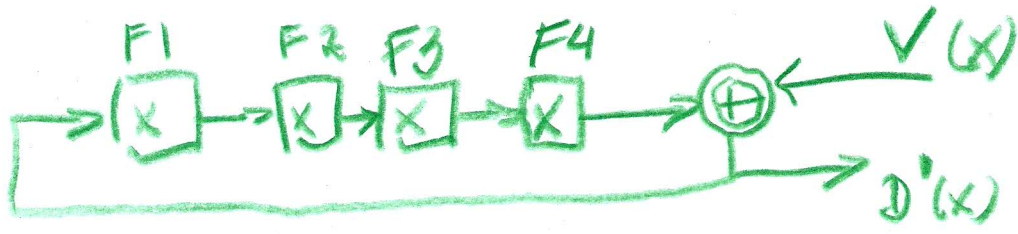
Exercício 9

$$G(x) = x + x^5$$

$$V(x) = D(x)G(x) = \underbrace{D(x)}_{D'(x)} \cdot x + D(x) \cdot x^5$$

$$V(x) = D'(x) + D'(x) \cdot x^4$$

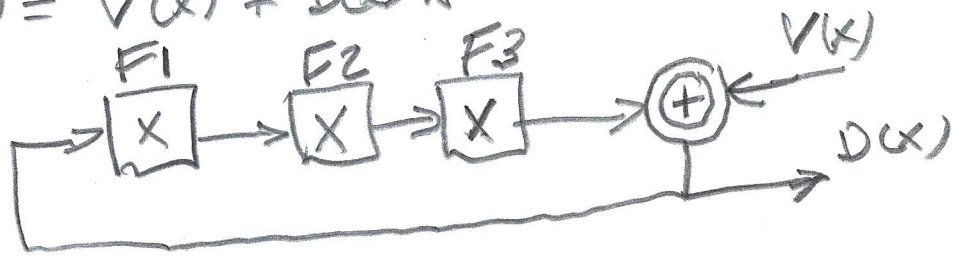
$$D'(x) = V(x) + D'(x) \cdot x^4$$



Exercício 10

$$G(x) = 1 + x^3 \quad V(x) = D(x) + D(x) \cdot x^3$$

$$D(x) = V(x) + D(x) \cdot x^3$$



Exercício 11

$$G(x) = x + x^3 \quad V(x) = D(x)G(x) = \underbrace{D(x)}_{D'(x)} \cdot x + D(x) \cdot x^3$$

$$D'(x) = V(x) + D'(x) \cdot x^2$$

