L3 E3A Partiel Électronique Numérique 2024

Exercice 1 :

1) $2^{16} = 65536 < 65563$ donc il faut 17 bits (en binaire naturel et en Ca2)

2) $1 Mio = 2^{20}$ octets $\Rightarrow 4 Mio = 4 \cdot 2^{20} \cdot 8$ bits $= 2^{25}$ bits

$1 Mot = 32$ bit $\Rightarrow$ on peut coder $\frac{2^{25}}{32}$ mots $= 2^{20}$ mots

Plus grande valeur : $2^{2^{25}} - 1$

3) 1 centième de kilooctet = 10 octets = 80 bits $\Rightarrow$ on peut coder 2^{80} nombres $\neq$

4) $(11,011)_2 = (3,375)_{10}$ et $(11,625)_{10} = (1011,101)_2$

Exercice 2 : 1) 1-a ; 2-d ; 3-c ; 4-b

2) $F_1 = \bar{A}.B.C + (A+\bar{A}).\bar{B}.\bar{C} + A.\bar{B}.C + A.B.C = (\bar{A}+A).BC + \bar{B}.\bar{C} + A.\bar{B}.C$

$= BC + \bar{B}.(\bar{C} + AC) = BC + \bar{B}(\bar{C}+A) = A\bar{B} + \overline{B \oplus C}$

$F_2 = (A.\bar{B}.C + A.\cancel{\bar{B}}\,\bar{B}.D + \bar{A}.\bar{B}).C = A.\bar{B}.C.C + \bar{A}.\bar{B}.C = (A+\bar{A}).\bar{B}.C = \bar{B}.C$

$F_3 = A.B.C.(A.B + \bar{C}.C.(B+A)) = A.B.C$

3) $F_4 = \bar{A}.\bar{B}.(C+\bar{C}) + A.B.\bar{C}.D = \bar{A}.\bar{B}.C + \bar{A}.\bar{B}.\bar{C} + A.B.\bar{C}.D$

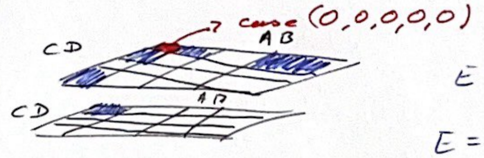
$= \bar{A}.\bar{B}.C(D+\bar{D}) + \bar{A}.\bar{B}.\bar{C}.(D+\bar{D}) + AB\bar{C}D = \bar{A}\bar{B}CD + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} + AB\bar{C}D$

4)

F_5 (CD \ AB)	00	01	11	10
00	1	0	1	1
01	0	0	0	0
11	0	0	0	0
10	1	0	1	1

$F_5 = A.\bar{D} + \bar{B}.\bar{D} = (A+\bar{B}).\bar{D}$

5)



E = 0

E = 1

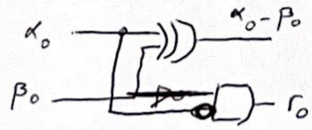
$\Rightarrow$ 5 cases adjacentes : (01000) ; (00010) ; (10000) ; (00100) ; (00001)

Exercice 3 :

1) $(-1)_{10} = (11)_{C2}$; $(0)_{10} = (00)_{C2}$ et $(1)_{10} = (01)_{C2}$

α_0	β_0	$\alpha_0 - \beta_0$	r_0
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

$\Rightarrow r_0 = \bar{\alpha}_0 \beta_0$ et $\alpha_0 - \beta_0 = \alpha_0 \oplus \beta_0$



2)

1110 → représente "-1"

$$\begin{array}{r} 17 \\ -03 \\ \hline =14 \end{array} \qquad \begin{array}{r} +10001 \\ -00011 \\ \hline (01110)_{C2} \end{array} = (2+4+8)_{10} = 14$$

$$\begin{array}{r} 17 \\ -20 \\ \hline =-3 \end{array} \qquad \begin{array}{r} -11000 \\ +10001 \\ -10100 \\ \hline 111101 \end{array} = (-32+16+8+4+1)_{10} = (-3)_{10}$$

car $-1+1-1 = -1$

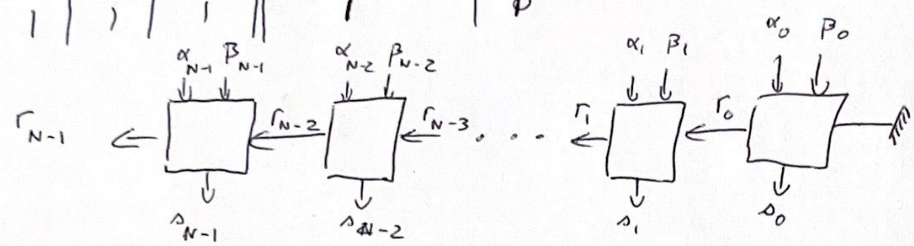
3) Il faut prendre en compte l'éventuelle retenue précédente. La TdV (2) du ½ soustracteur devient

r_{i-1}	α_i	β_i	$s_i = \alpha_i - \beta_i - r_{i-1}$	r_i
0	0	0	0	0
0	0	1	1	1
0	1	0	1	0
0	1	1	0	0
1	0	0	1	1
1	0	1	0	1
1	1	0	0	0
1	1	1	1	1

$\rightarrow -1-1 = (-2)_{10} = (10)_{C2}$

$\Rightarrow s_i = \alpha_i \oplus \beta_i \oplus r_{i-1}$

$r_i = \bar{\alpha}_i \beta_i + (\overline{\alpha_i \oplus \beta_i}) \cdot r_{i-1}$



Exercice 4 : A l'aide du chronogramme on obtient la TdV

c	b	a	s
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

$\Rightarrow$

s \ ab	00	01	11	10
c = 0	0	0	1	0
c = 1	1	0	1	1

$s = a.b + \bar{b}.c$. Avec l'aide du schéma on obtient $s = \bar{a}\ P_1\ \bar{b}\ P_2\ \underbrace{(\overline{b + \bar{c}})}_{\bar{b}.c}$ avec $P_{i=1,2} = +,\ \oplus,\ \dots$ etc.

Par identification on a P_2 = porte ET

P_1 = porte NAND

Exercice 5 :

1) $(102)_3 = (2 \times 3^0 + 0 \times 3^1 + 1 \times 3^2)_{10} = (2+9)_{10} = (11)_{10}$

2) Le nb décimal max est donné par $(\underbrace{22 \dots 2}_{T})_3 = (2 \times 3^0 + 2 \times 3^1 + \dots + 2 \times 3^{T-1})_{10}$

$= 2 \sum_{M=0}^{T-1} 3^M = 2 \frac{1-3^T}{1-3}$

$= 3^T - 1$

3) D'après Q2. $T=2 \Rightarrow Nb_{max} = 8$

$T=3 \Rightarrow Nb_{max} = 26$

$T=4 \Rightarrow Nb_{max} = 80$

$T=5 \Rightarrow Nb_{max} = 242$

$80 \leq 120 \leq 242 \Rightarrow$ 5 chiffres

4) Méthode 1 : Division

$$\begin{array}{l} 120 \div 3 = 40 \text{ reste } 0 \\ 40 \div 3 = 13 \text{ reste } 1 \\ 13 \div 3 = 4 \text{ reste } 1 \\ 4 \div 3 = 1 \text{ reste } 1 \\ 1 \end{array}$$

$\Rightarrow (120)_{10} = (11110)_3$

5)
$$\begin{array}{rcl} & (201)_3 & \rightarrow (19)_{10} \\ + & (012)_3 & \rightarrow (5)_{10} \\ \hline & (220)_3 & \leftarrow (24)_{10} \end{array}$$

Exercice 6 :

1)

A_0	A_1	A_2	R	I_0	I_1	I_2
0	0	0	0	0	0	1
0	0	1	0	0	1	0
0	1	0	0	0	1	1
0	1	1	0	1	0	0
1	0	0	0	1	0	1
1	0	1	0	1	1	0
1	1	0	0	1	1	1
1	1	1	1	0	0	0

$R = A_0 . A_1 . A_2$

I_1: A_0 \ A_1A_2	00	01	11	10
0	0	1	0	1
1	0	1	0	1

$I_1 = \bar{A}_1 A_2 + A_1 \bar{A}_2$
$= A_1 \oplus A_2$

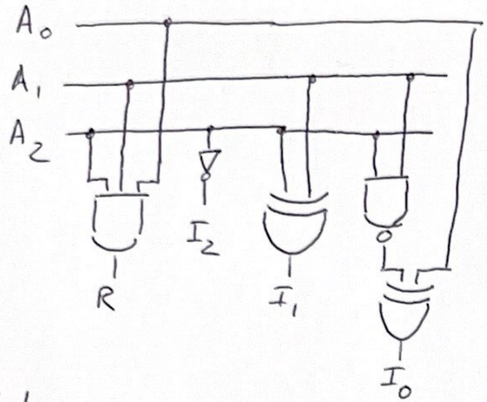
I_0: A_0 \ A_1A_2	00	01	11	10
0	0	0	1	0
1	1	1	0	1

$I_0 = \bar{A}_0 A_1 A_2 + A_0 \bar{A}_1 + A_0 \bar{A}_2$

$= A_0 \oplus \overline{A_1 A_2}$

I_2: A_0 \ A_1A_2	00	01	11	10
0	1	0	0	1
1	1	0	0	1

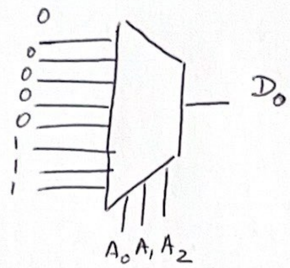
$I_2 = \bar{A}_2$



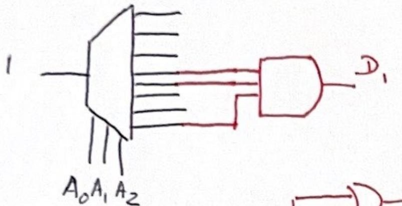
2)

A_0	A_1	A_2	D_0	D_1	D_2
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	1
0	1	1	0	1	0
1	0	0	0	1	1
1	0	1	1	0	0
1	1	0	1	0	1
1	1	1	1	1	0

3)



4)



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