Sistemas Digitais

Nota final = 60% Teórica + 40% Laboratório >= 9,5 val. 22/11/2

2 MAP45 ou 1 Exame

- MAP45_1 (30%): 20/12/2022 18:15h
- MAP45_2 (30%), Exame (60%): 27/01/2023 8:00h
- Exame recurso (60%): 06/02/2023 8:00h

} Nota mínima em cada 8 valores

Lab → 5 trabalhos (L1 (6%), L2 (8%), L3 (8%), 4 (8%), L5 (10%)) – Nota mínima 9,5 valores

Representação Digital de informação

Representação de números em base b

b = 7	b = 10	b = 16
0, 1, 2, 3, 4, 5, 6	0, 1, ..., 9	0, 1, 2, 3, ..., 9, A, B, C, D, E, F

Conversão entre números de base 10 para base b

ex:

$273_{10} = ?_5$

$273_{10} = 2043_5$

```
273 | 5
 23  54 | 5
(3)  04  10 | 5
     (4)  0  2 | 5
          (2)  0
```

ex:

$20_{10} = ?_2$

$20_{10} = 10100_2$

```
20 | 2
(0) 10 | 2
    (0)  5 | 2
         (1)  2 | 2
              (0)  1 | 2
                   (1)  0
```

3CD ≠ binário

Problemas 1 - Representação Digital de Informação — em casa

1) $2^{-3} = \frac{1}{8} = 0,125$ $2^{-2} = \frac{1}{4} = 0,25$ $2^{-1} = \frac{1}{2} = 0,5$ $2^0 = 1$ $2^1 = 2$ $2^2 = 4$ $2^3 = 8$ $2^4 = 16$

$2^5 = 32$ $2^6 = 64$ $2^7 = 128$ $2^8 = 256$ $2^9 = 512$ $2^{10} = 1024 = 1K$ $2^{11} = 2048 = 2K$

$2^{12} = 4096 = 4K$ $2^{13} = 8192 = 8K$ $2^{14} = 16384 = 16K$ $2^{15} = 32768 = 32K$

$2^{25} = 32M$ $2^{35} = 32G$

2) 10905_{10}

b=16

10905 | 16
130 681 | 16
25 41 42 | 16
9 9 10 2 | 16
A 2 0

$10905_{10} = 2A99_{16}$

$0010\,1010\,1001\,1001_2$

b=2

10905 | 2
09 5452 | 2
10 14 27 26 | 2
05 05 07 13 6 | 2
1 12 12 16 6 8 | 2
0 06 03 08 3 4 0 | 2
0 1 01 14 17 0 | 2
1 00 10 8 5 | 2
0 0 05 4 2 | 2
1 02 2 1 | 2
0 01 10 | 2
1 0 5 | 2
1 2 | 2
0 1 | 2
1 0

$10905_{10} = 10101010011001_2$

b=4

10905 | 4
29 2726 | 4
10 32 681 | 4
25 06 28 170 | 4
1 2 01 10 42 | 4
2 02 10 | 4
2 2 | 4
2 0

$10905_{10} = 2222214$

3)

a) $101011,11010_2 = 107,8125_{10}$

$101011_2 = 2^6 + 2^5 + 2^3 + 2^1 + 1 = 64 + 32 + 8 + 2 + 1 = 107_{10}$

$0,11010_2 = 2^{-1} + 2^{-2} + 2^{-4} + 2^{-5} = \frac{1}{2} + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} = 0,8125_{10}$

$0,5 + 0,25 + 0,0625 + 0,015625$

$\frac{1}{64} < \frac{1}{10}$

$\frac{1}{64} > \frac{1}{100}$

b) $426,73_{10} = 110101010,10111_2$

426 | 2
02 213 | 2
06 01 106 | 2
0 13 06 53 | 2
1 0 13 26 | 2
1 06 13 | 2
0 1 6 | 2
0 3 | 2
1 1 | 2
1 0

$0,73 \times 2 = 1,46 = 1$

$0,46 \times 2 = 0,92 = 0$

$0,92 \times 2 = 0,84 = 1$

$0,84 \times 2 = 1,68 = 1$

$0,68 \times 2 = 1,36 = 1$

$0,36 \times 2 = 0,72 = 0$

$0,72 \times 2 = 1,44 = 1$

$0,10111101$

$\frac{1}{2^1} \cdot \frac{1}{2^3} \quad \frac{1}{2^6} \cdot \frac{1}{64}$

Faça 7 para arredondar para 6

by Staples

4) $BEBE_{16} = 11 \times 16^3 + 14 \times 16^2 + 11 \times 16^1 + 14 = 11 \times 4096 + 14 \times 256 + 11 \times 16 + 14 = 48830_{10}$

1011 1110 1011 1110₂ =

5)

a) A = 2427 = 0010 0100 0010 0111

B = -2427 = - 0010 0100 0011 0010 0111

C = 0,23 = 0000,0010 0011

b) 1 0010 0111 0000 0111

1) $2^{15} + 2^{12} + 2^9 + 2^8 + 2^7 + 2^2 + 2^1 + 2^0 = 37767_{10}$

2) 9387

6) ISI-Tagus Park = 49 53 54 20 2D 20 54 61 67 75 73 20 50 61 72 6B$_{16}$ =

= 1001001 1010011 1010100 0100000 0101101 0100000 1010100 1100001 1100111
1110101 1110011 0100000 1010000 1100001 1110010 1101011

7) $35_x < 64_{10}$ $x = ?$ $x \leq 19$

$35_1 = 3+5 = 8_{10}$ $35_5 = 3 \times 5 + 5 = 20_{10}$ $35_9 = 3 \times 9 + 5 = 32_{10}$

$35_2 = 3 \times 2 + 5 = 11_{10}$ $35_6 = 3 \times 6 + 5 = 23_{10}$ $35_{10} =$

$35_3 = 3 \times 3 + 5 = 14_{10}$ $35_7 = 3 \times 7 + 5 = 26_{10}$ $35_{11} = 3 \times 11 + 5 = 38_{10}$

$35_4 = 3 \times 4 + 5 = 17_{10}$ $35_8 = 3 \times 8 + 5 = 29_{10}$ $35_{12} = 3 \times 12 + 5 = 41_{10}$

$35_{13} = 3 \times 13 + 5 = 44_{10}$ $35_{14} = 3 \times 14 + 5 = 47_{10}$ $35_{15} = 3 \times 15 + 5 = 50_{10}$

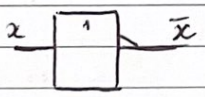
$35_{16} = 3 \times 16 + 5 = 53_{10}$ $35_{17} = 3 \times 17 + 5 = 56_{10}$ $35_{18} = 3 \times 18 + 5 = 59_{10}$

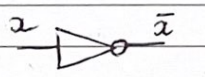
$35_{19} = 3 \times 19 + 5 = 62_{10}$ $35_{20} = 3 \times 20 + 5 = 65_{10}$

not

24/11/2022

$f(x) = \bar{x}$



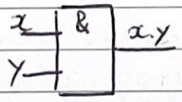


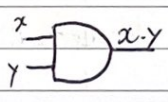
inversores (INV)

$\bar{\bar{x}} = x$

and

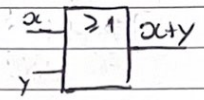
$\wedge$

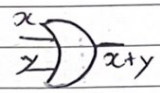




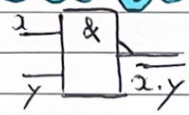
or

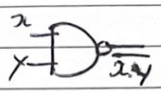
V



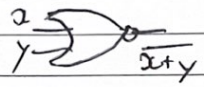


nand

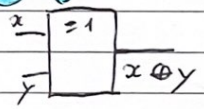


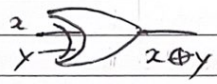


nor



xor



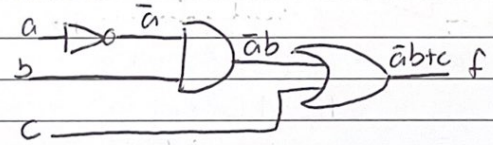


ex. comutador de escada:

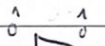
i_1	i_0	f
0	0	0
0	1	1
1	0	1
1	1	0

xor

$f = \bar{a}b + c$



-> isto é um logigrama



buffer

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teorema absorção: $x(x+y) = xx + xy = x + xy = x(1+y) = x(1) = x$

$x + xy = x(1+y) = x(1) = x$

$(x+y)(x+\bar{y}) = \overset{x}{x\bar{x}} + x\bar{y} + yx + \overset{0}{y\bar{y}} = x + x\bar{y} + yx = x + x(\overset{1}{\bar{y}+y}) = x + x = x$

$x \oplus \bar{y} = \bar{x}y + x\bar{y}$

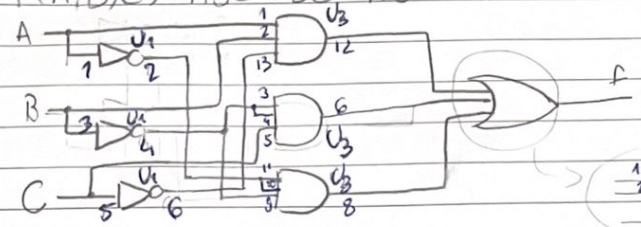
$x + \bar{x}y = (x+\bar{x})(x+y) = 1(x+y) = x+y$

Problemas 2 - Representação e simplificação de funções

em ~~casa~~ aula

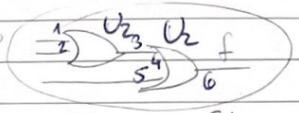
1) $f(A,B,C) = AB\bar{C} + \bar{B}C + \bar{A}\bar{B}$

a)



3 74XX
74LS04 → 6x
74LS11 → 3x
74LS32 → 4x

U1 = 74HCT04
U2 = 74HCT32
U3 = 74HCT11



Não existem CI com 3-InOR

a	b	c	$\bar{a}$	$\bar{a}b$	$f = \bar{a}b + c$	
0	0	0	1	0	0	
0	0	1	1	0	1	
0	1	0	1	1	1	→ aula de ontem
0	1	1	1	1	1	
1	0	0	0	0	0	
1	0	1	0	0	1	
1	1	0	0	0	0	
1	1	1	0	0	1	

b)

A	B	C	$\bar{A}$	$\bar{B}$	$\bar{C}$	$AB\bar{C}$	$\bar{B}C$	$\bar{A}\bar{B}$	f	
0	0	0	1	1	1	0	0	1	1	← 1
0	0	1	1	1	0	0	1	1	1	← 2
0	1	0	1	0	1	0	0	0	0	
0	1	1	1	0	0	0	0	0	0	
1	0	0	0	1	1	0	0	0	0	
1	0	1	0	1	0	0	1	0	1	← 3
1	1	0	0	0	1	1	0	0	1	← 4
1	1	1	0	0	0	0	0	0	0	

30/11/2022

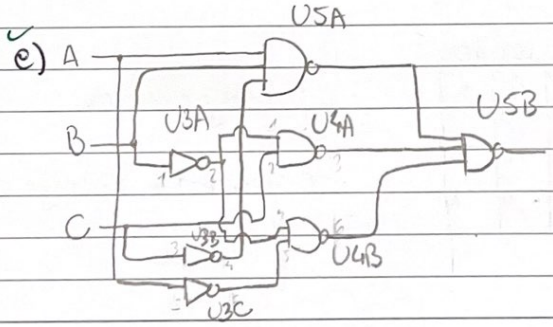
e) são os azuis números em a) e

c) $f = \Sigma m(0,1,5,6) = \underbrace{\bar{A}\bar{B}\bar{C}}_{①} + \underbrace{\bar{A}\bar{B}C}_{②} + \underbrace{A\bar{B}C}_{③} + \underbrace{AB\bar{C}}_{④}$

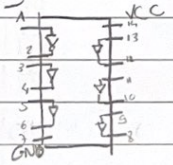
$= \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C + AB\bar{C} =$
$= \bar{A}\bar{B}(\bar{C}+C) + \bar{B}C(\bar{A}+A) + AB\bar{C} =$
$= \bar{A}\bar{B}(1) + \bar{B}C(1) + AB\bar{C} =$
$= \bar{A}\bar{B} + \bar{B}C + AB\bar{C}$

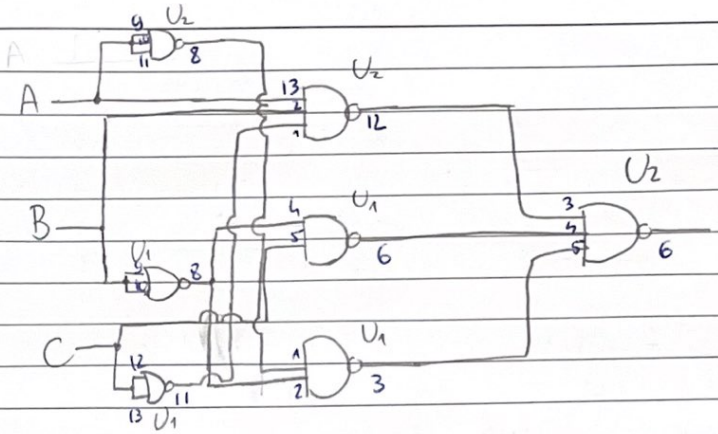
d) $f(A,B,C) = AB\bar{C} + \bar{B}C + \bar{A}\bar{B} = \overline{AB\bar{C}} \cdot \overline{\bar{B}C} \cdot \overline{\bar{A}\bar{B}}$

e)



74HCT04





g) 2

2)

a) $f(A,B,C) = A\bar{B}\bar{C} + ABC + A\bar{B} = AB(\bar{C}+C) + A\bar{B} = AB(1) + A\bar{B} = A(B+\bar{B}) = A(1) = A$

b) $f(A,B,C) = (A+B+\bar{C})\bar{A}\bar{B}\bar{C} + C = A\bar{A}\bar{B}\bar{C} + B\bar{A}\bar{B}\bar{C} + \bar{C}\bar{A}\bar{B}\bar{C} + C = 0.\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + C =$
$= \underbrace{\bar{A}\bar{B}\bar{C}}_{Y} + \underbrace{C}_{R} + \underbrace{C}_{X} = C + \bar{A}\bar{B}$

c) $f(A,B,C) = \overline{A\bar{B} \oplus C} + A = \overline{A\bar{B}} \oplus C + A = AB \oplus C + A = \overline{AB}C + AB\bar{C} + A = \overline{AB}C + A(B\bar{C}+1) =$
$= \overline{AB}C + A(1) = (\bar{A}+\bar{B})C + A = \bar{A}C + \bar{B}C + A = A + C + \bar{B}C = A + C(1+\bar{B}) = A + C$

$\bar{x}+x = 1$	$x+\bar{x}y = x+y$	$x.(x+y) = x$	$\overline{x \oplus y} = \bar{x} \oplus y$
$x.1 = x$	$x.(\bar{x}+y) = xy$	$x+xy = x$	$x \oplus y = \bar{x}y + x\bar{y}$

mapas de Karnaugh

30/11/2022

A \ BC	00	01	11	10
0	0	1	3	2
1	4	5	7	6

cada posição tem 3 adjacentes
(para cada uma só muda uma variável

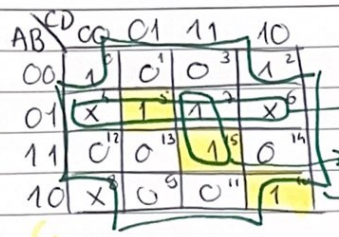
5 dígitos

AB \ CDE	000	001	011	010	110	111	101	100
00	0	1	3	2	6	7	5	4
01	8	9	11	10	14	15	13	12
11	24	25	27	26	30	31	29	28
10	16	17	19	18	22	23	21	20

• → adjacências

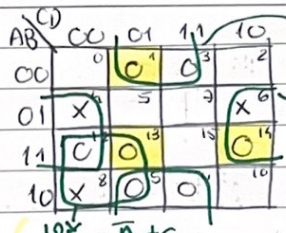
cada 1

06/12/2022



através de mintermos

$f = \bar{A}B + BCD + \bar{B}\bar{D}$



através de Maxtermos

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

Representação em complemento para 2

0110

↓ ↓ ↓ ↓

1001 → complemento para 1

\+ 1

1010 → complemento para 2

11010 | 100

00101 | 100

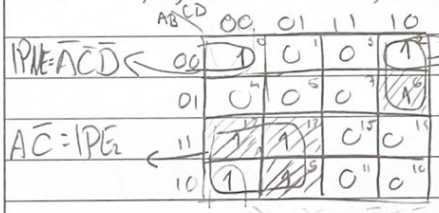
07/12/2022

Problemas

Minimização de funções (método de Karnaugh)

1)

a) $f(A,B,C,D) = \sum m(0,7,6,8,5,12,13)$



$f = \bar{A}C\bar{D} + A\bar{C} + \bar{A}\bar{C}\bar{D}$

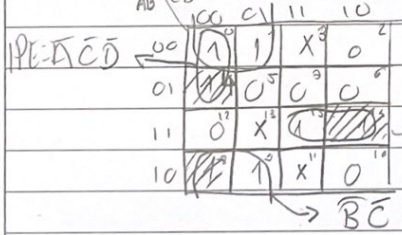
ou

$\bar{B}C\bar{D}$

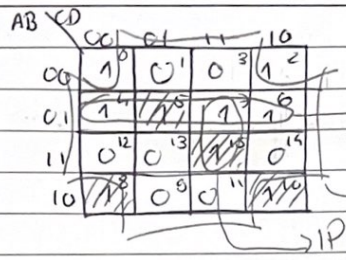
Implicante primo
agrupamento válido que não pode ser alargado

Implicante primo essencial
contem pelo menos um mintermo que não pode ser associado de outra maneira

b) $f(A,B,C,D) = \sum m(0,1,4,8,5,15)$ com indiferenças (3,11,13



$f = \bar{A}\bar{C}\bar{D} + \bar{B}\bar{C} + ABC$



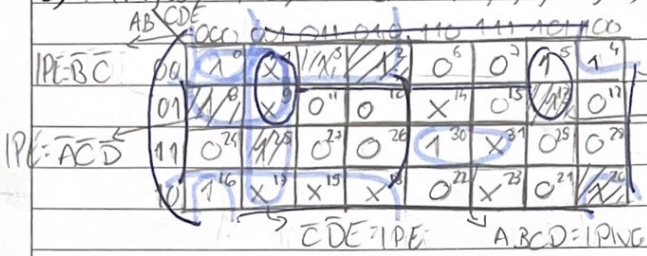
$\rightarrow IPE = \bar{A}B$

$\rightarrow IPE = \bar{B}\bar{D}$

$\rightarrow IPE = BCD$

$f = \bar{A}B + \bar{B}\bar{D} + BCD$

2) $f(A,B,C,D,E) = \sum m(0,2,3,4,5,8,13,16,20,25,30)$ indiferenças (1,5,14,19,18,15,23,31



$IPE = B\bar{C}$

$\rightarrow \bar{B}\bar{D}\bar{E} = IPE$

$\rightarrow \bar{A}\bar{D}E = IPE$

$IPE = \bar{A}\bar{C}\bar{D}$

$C\bar{D}E = IPE$

$ABCD = IPIVG$

$f = B\bar{C} + C\bar{D}E + \bar{A}\bar{C}\bar{D} + B\bar{D}\bar{E} + \bar{A}\bar{D}E + ABCD$

3)

a)
$$\begin{array}{r} {\scriptstyle 1\ 1\ 1\ \ 1\ \ \ \ } \\ 11111101 \\ +100110001 \\ \hline 1001001110 \end{array}$$

b)
$$\begin{array}{r} {\scriptstyle 1\ \ 1\ \ \ \ } \\ 1A22FO \\ +\ \ D81B \\ \hline 1B4BOB \end{array}$$

$+1 \rightarrow 000001$ } 6 bits

$-1 \rightarrow 111111$ } 8 bits

$-1 \rightarrow 11111111$

$+127 \rightarrow 01111111$

$-128 \rightarrow 10000000$

$-127 \rightarrow 10000001$

$-126 \rightarrow 10000010$

106

4)

a) $27 = 011011$

$-27 = 100101$

b) $106 = 01101010$

$-100 = 10011100$

106 } Não dá com 6 bits

-100

$64+32 = 96+16 = 104+2 = 106$

$100 = 01100100$ $\quad 96+4$

e) ✓ dá overflow

$$\begin{array}{r} 106 \\ +27 \\ \hline 133 \end{array}$$

$$\begin{array}{r} 106 \\ -100 \\ \hline 6 \end{array}$$

não dá overflow

$$\begin{array}{r} 106 \\ 27 \\ \hline \end{array} \quad \begin{array}{r} 01101010 \\ 00011011 \\ \hline 11111101 \end{array}$$

(+) overflow

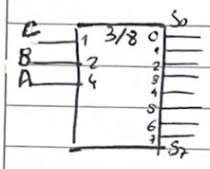
(-)

Problemas

14/12/2022

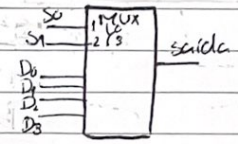
Circuitos Combinatórios Típicos, Circuitos Aritméticos

Descodificador



A	B	S_0	S_1	S_2	S_3
0	0	1			
0	1		1		
1	0			1	
1	1				1

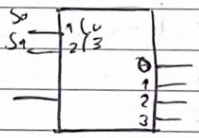
Multiplexer



S_0	S_1	saída
0	0	D_0
0	1	D_1
1	0	D_2
1	1	D_3

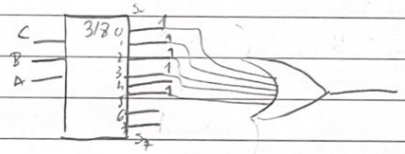
1) $f(A,B,C) = \bar{A}B + \bar{A}\bar{C} + \bar{B}C = \Sigma m(0,1,2,3,5)$

Demultiplexer

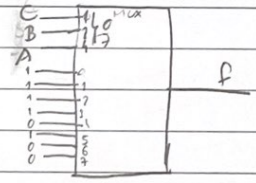


a) desc 3:8 + uma porta

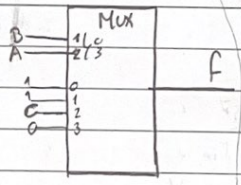
$\bar{A}B$	$\bar{A}\bar{C}$	$\bar{B}C$
01x	0x0	x01
010 → 2	010 → 2	101 → 5
011 → 3	000 → 0	001 → 1



b)



c)



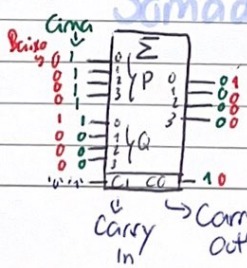
A	B	C	f
1	0	0	1
	0	1	1
1	1	0	1
	1	1	1
0	0	0	0
	0	1	1
0	1	0	0
	1	1	0

2) a) $0101 = 5$

$1110 = -2$

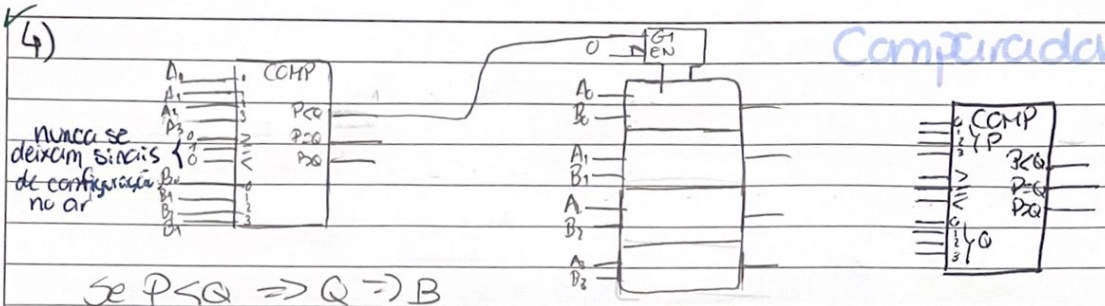
b) $0100 = 4$

Somador



$$\begin{array}{r} \text{Carry Out} \quad 1\,1\,1\,0 \leftarrow \text{Carry In} \\ 1 \quad 1111 \\ \hline 0001 \\ \hline 0000 \end{array}$$

4)



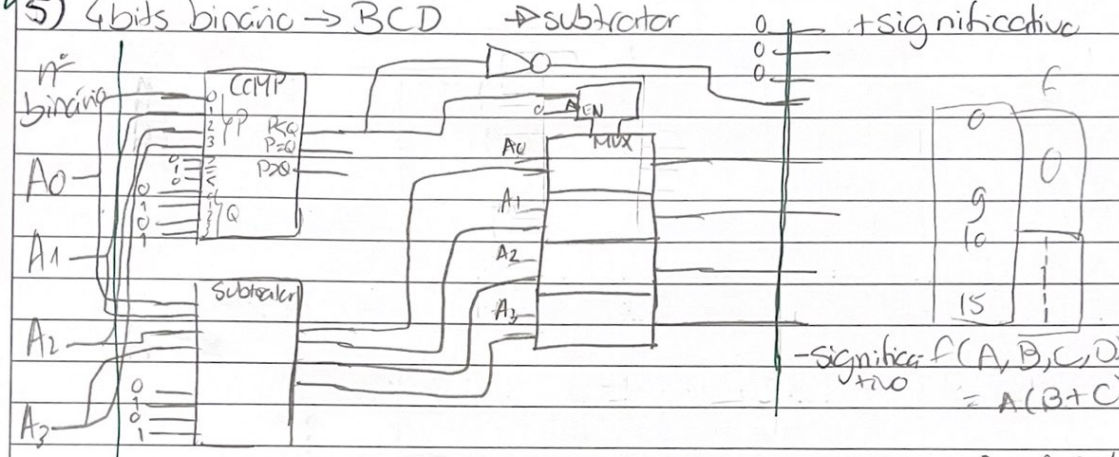
Comparador

Se P<Q => Q => B

Se P=Q

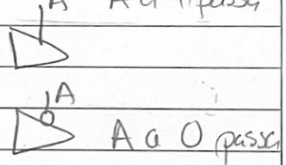
Se P>Q => P => A

5) 4bits binário → BCD → subtrator



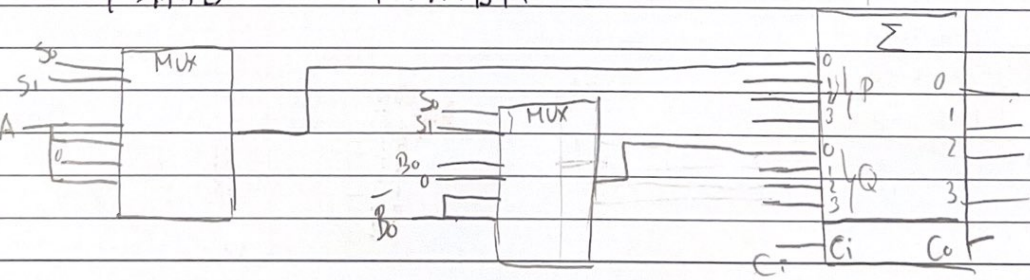
6) $h = m_2 + m_3 + m_4 + m_7$ $\quad g = \overline{m_1} \cdot \overline{m_2} \cdot \overline{m_5} \cdot \overline{m_6}$

$f = A \cdot g + \bar{A} h$



15/12/2022

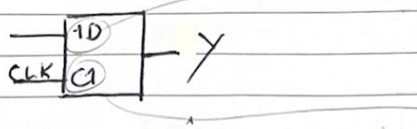
S1 S0	Ci = 0	Ci = 1
00	F = A+B	F = A+B+1
01	F = A	F = A+1
10	F = $\overline{B}$	F = $\overline{B}$+1
11	F = A+$\overline{B}$	F = A+$\overline{B}$+1



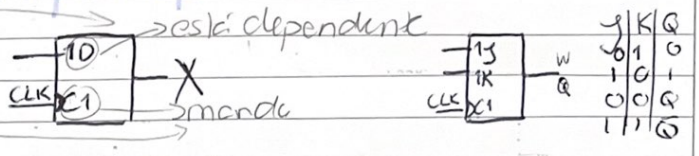
Problemas

21/12/2022

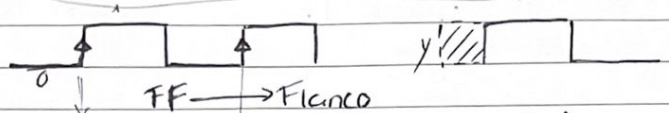
Latches



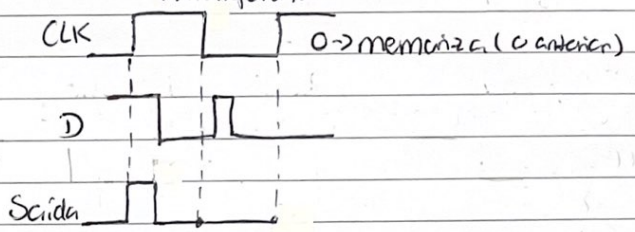
Flip-Flop



J	K	Q
0	1	0
1	0	1
0	0	Q
1	1	$\bar{Q}$

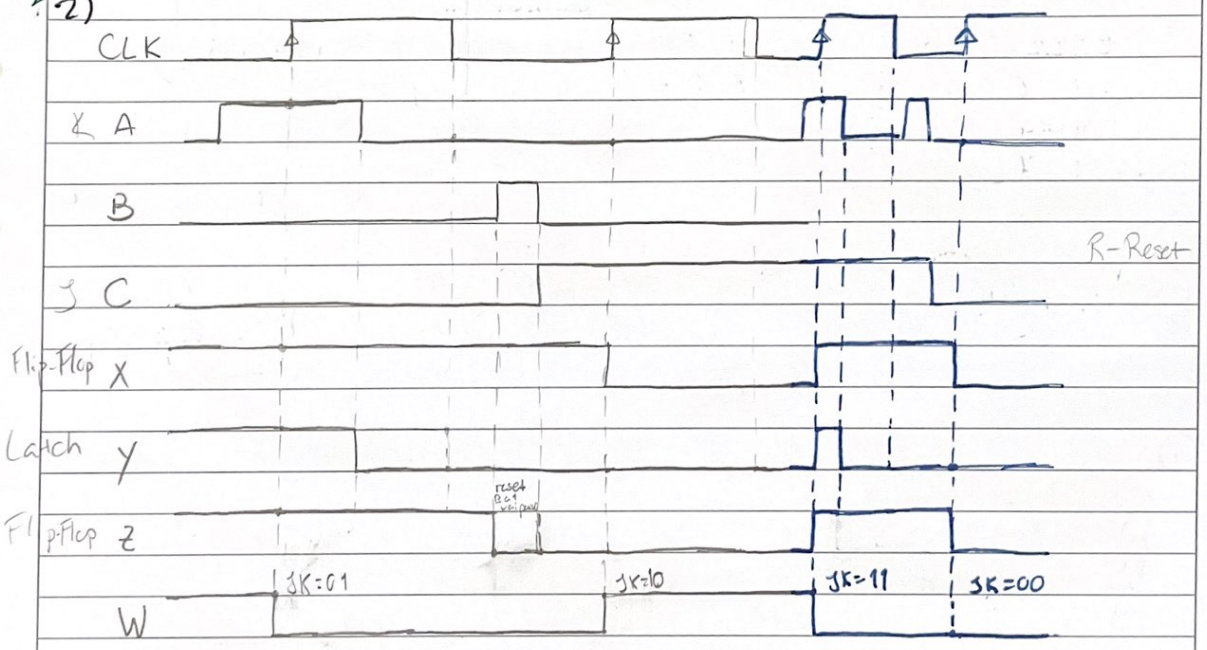


Latch → Nível
1 → transparente (o que está na entrada sai)



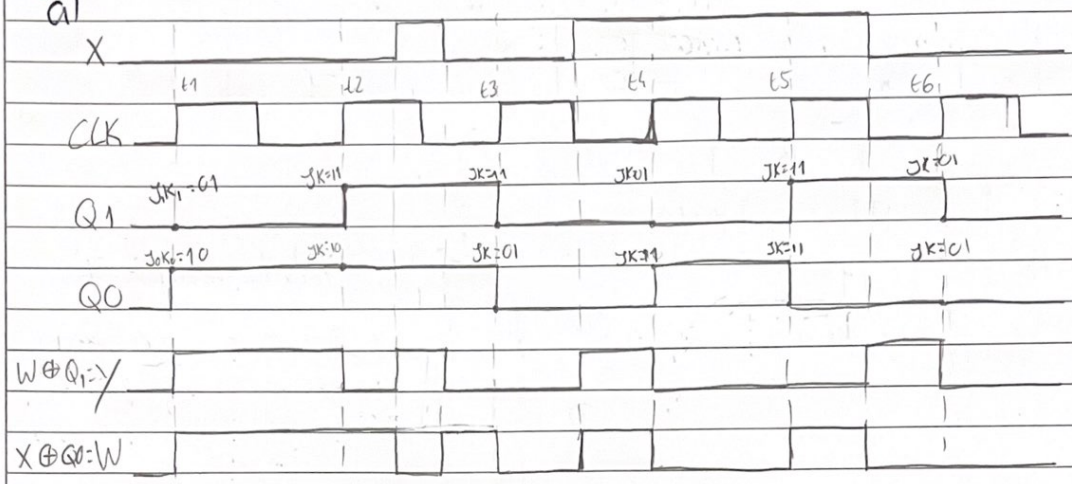
ALU's; Latches e Flip-Flops, Registos (1)

2)



3)

a)



b) FF JK

$t_{setup} = 15\,ns$

$t_{hold} = 2\,ns$

$t_{PHL/LH} = 40\,ns$

OR

$t_{PHL/LH} = 30\,ns$

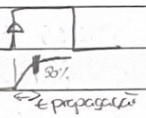
XOR

$t_{PHL/LH} = 20\,ns$

C1 → FF0 → FF1

$t_{PFF0} + t_{setupFF1} = 40 + 15 = 55\,ns$

$t_{PFF1} + t_{POR} + t_{setupFF0} = 40 + 30 + 15 = 85\,ns$



$f = \frac{1}{85\,ns} = \frac{1}{85}\,GHz$

Problemas

04/01/2022

Contadores; Síntese de Circuitos Sequenciais Síncronos; Memórias

1) tem triângulo no clock → contador simples

a) Contador simples

b) Flip-flop JK

c) ascendentemente

d) C4, 2, 3

e) M1 - carregamento em paralelo M2 - contagem

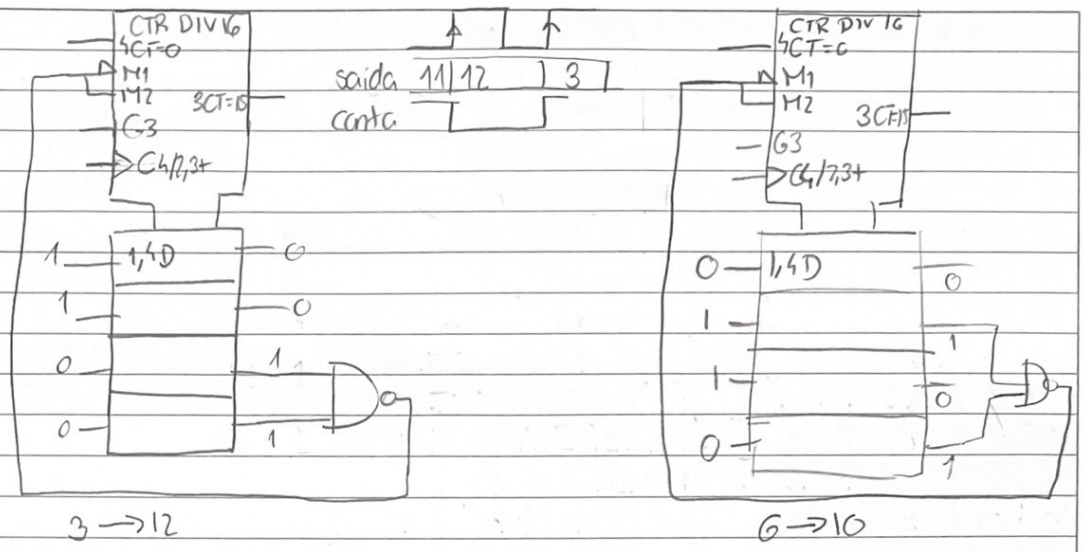
f) M1 - load M2 - cout 4CT=0 - Reset

g) Enable

h) 3CT=15 saída a 1 quando a contagem está a 15

i) →

g)



2)

a) Contador síncrono pq está dependente do clock

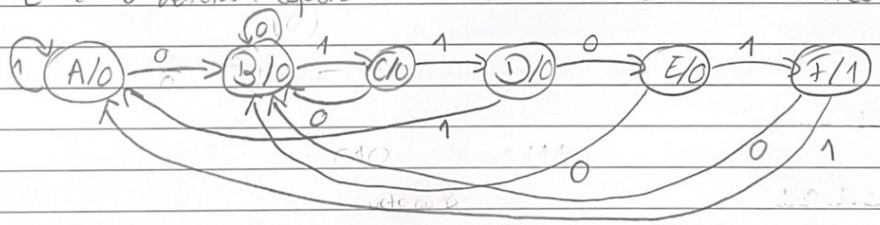
b) 1º contador → -peso
2º contador → +peso
00011100 → 00110000
28 → 48

3)

a) A - espera início da sequência
B - 1º "0" detetado / espera do 1º "1"
C - 1º "1" detetado / espera do 2º "1"
D - 2º "1" detetado / espera do 2º "0"
E - 2º "0" detetado / espera do 3º "1"
F - 3º "1" detetado / coloca Y=1 deteta a sequência

Moore - saída só depende do estado

Mealy - saída depende estado e entradas



0 1 0 — volta a B
0 1 1 1 — tem de voltar para A
0 1 1 0 0 — volta a B

Flip-Flop tipo D

6 estados → 3 FFD

	Q2	Q1	Q0
A	0	0	0
B	0	0	1
C	0	1	0
D	0	1	1
E	1	0	0
F	1	0	1

Passo 1 - decidir valor dos estados

Passo 2 - tabela estado presente estado seguinte

	Entrada	Estado presente			Estado seguinte			
	X	Q2	Q1	Q0	Q2	Q1	Q0	
A	0	0	0	0	B	0	0	1
B	0	0	0	1	B	0	0	1
C	0	0	1	0	B	0	0	1
D	0	0	1	1	E	1	0	0
E	0	1	0	0	B	0	0	1
F	0	1	0	1	B	0	0	1
G	0	1	1	0		x	x	x
H	0	1	1	1		x	x	x
A	1	0	0	0	A	0	0	0
B	1	0	0	1	C	0	1	0
C	1	0	1	0	D	0	1	1
D	1	0	1	1	A	0	0	0
E	1	1	0	0	F	1	0	1
F	1	1	0	1	A	0	0	0
G	1	1	1	0		x	x	x
H	1	1	1	1		x	x	x

Passo 4 - Estado presente - saída

	Q2	Q1	Q0	saída
A	0	0	0	0
B	0	0	1	0
C	0	1	0	0
D	0	1	1	0
E	1	0	0	0
F	1	0	1	1
G	1	1	0	x
H	1	1	1	x

saída = Q2Q0

Q2 \ Q1Q0	00	01	11	10
0	0	0	0	0
1	0	1	x	x

↳ Q2Q0

Passo 3 - Mapas de Karnaugh para obter entradas de FF

XQ2 \ Q1Q0	00	01	11	10
00	0	0	1	0
01	0	0	x	x
11	1	0	x	x
10	0	0	0	0

D2

XQ2 \ Q1Q0	00	01	11	10
00	0	0	0	0
01	0	0	x	x
11	0	0	x	x
10	0	1	0	1

D1

XQ2 \ Q1Q0	00	01	11	10
00	1	1	0	1
01	1	1	x	x
11	1	0	x	x
10	0	0	0	1

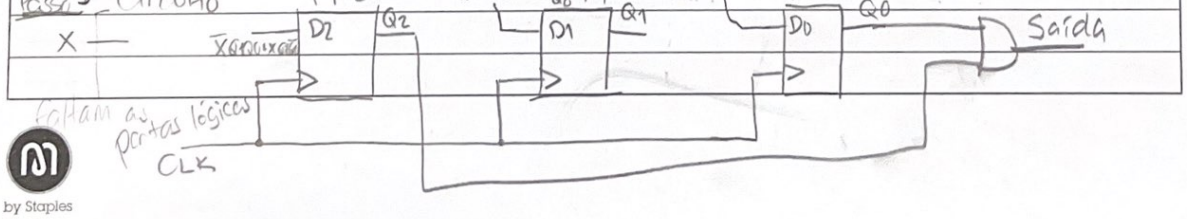
D0

$D2 = \bar{X}Q1Q0 + XQ2\bar{Q}0$

$D1 = XQ1\bar{Q}0 + X\bar{Q}2\bar{Q}1Q0$

$D0 = \bar{X}\bar{Q}1 + Q2\bar{Q}0 + Q1\bar{Q}0$

Passo 5 - Circuito



Faltam as portas lógicas

by Staples

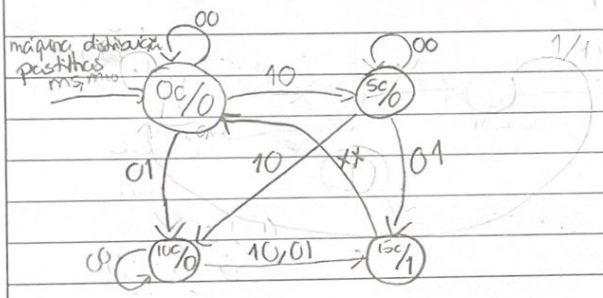
no 4b) com flip-flop JK fazer tabela transição de D para JK

JK	Q
00	→ Q
01	→ 0
10	→ 1
11	→ $\overline{Q}$

	JK	D
0 → 0	0 X	0
0 → 1	1 X	1
1 → 0	X 1	0
1 → 1	X 0	1

tabela J2K2 em vez de Q2 tabela anterior

J2K2
0 X
0 X
0 X
1 X
0 X
0 X
X X
X X
X 1
. .
12 – X0



10 – 5c
01 – 10c

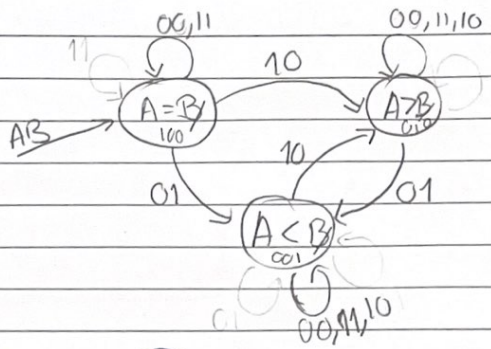
05/01/2023

	EP Q1 Q0	Entradas MS	Entradas MIO	ES D1	ES D0	Saídas
S0	0 0	0	0	0	0	0
	0 0	0	1	0	0	
	0 0	1	0	1	0	
	0 0	1	1	1	1	
S5	0 1	0	0	0	1	0
	0 1	0	1	0	1	
	0 1	1	0	1	0	
	0 1	1	1	1	1	
S10	1 0	0	0	0	0	0
	1 0	0	1	0	0	
	1 0	1	0	1	0	
	1 0	1	1	1	1	
S15	1 1					1

D1 (MS MIO)

Q1Q0 \	00	01	11	10
00	0 (0)	1 (1)	X (3)	0 (2)
01	0 (4)	1 (5)	X (7)	1 (6)
11	0 (12)	0 (13)	X (15)	0 (14)
10	1 (8)	1 (9)	X (11)	1 (10)

Comparador Série



Capítulo 6 e 7

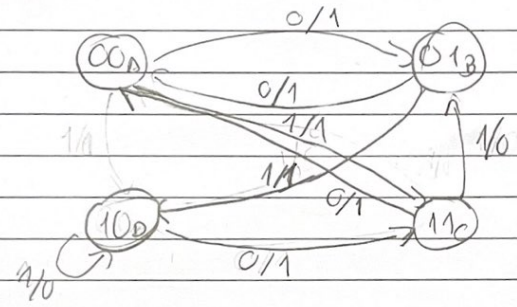
11/01/2023

Contadores; Síntese de Circuitos Sequenciais Síncronos; Memórias

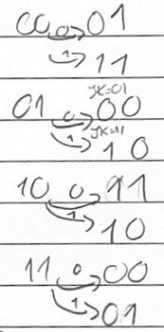
5)

a) Mealey

b)

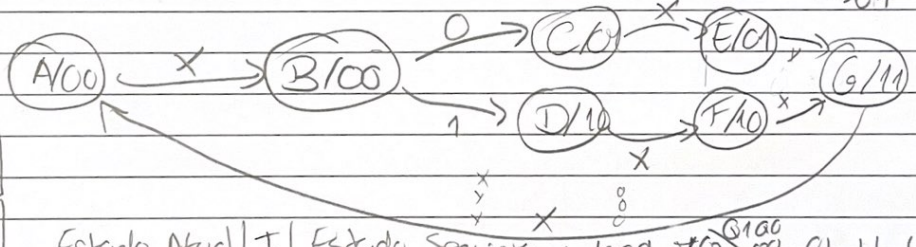


$Z = \overline{X} \cdot Q1$



6)

A 000
B 001
C 010
D 011
E 100
F 110
G 100



Estado Atual	I	Estado Seguinte	load
B 001	1	D 101	1
F 110	X	G 100	1
G 100	X	A 000	1
Q2 Q1 Q0		D2 D1 D0	

I Q2Q0	00	01	11	10
00				
01	0			1
11	0			1
10		1		

$D2 = Q1 + Q0$

0 ← 00 ← valor carregamento em paralelo

Q2Q0	00	01	11	10
00	0	0	0	0
01	1	0	0	1
11	1	0	0	1
10	0	1	0	0

$load = Q2\overline{Q0} + I\overline{Q1}\overline{Q0}$

a) RAM - Random access memory
ROM - Read only memory
PROM - Programable
EPROM - Erasable programable
EEPROM - Eletrical erasable
Flash - escreve-se mais rapido mas lê-se mais lento que RAM mas mantem o que está escrito mesmo sem energia

Ver definições nos slides

b) escrever → WE_L → 0 dados → o que queremos escrever
CS_L → 0 endereço → onde queremos escrever
ler → WE_L → 1
CS_L → 0 endereço → onde queremos ler

c)

d)