F. I. M. E.

ELECTRONICA LOGICA I

ING JUAN ANGEL GARZA GARZA

HORA: V-6

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MAT. 385980

ELECTRÓNICA LÓGICA I

ING. JUAN ANGEL GARZA GARZA.

I.- INTRODUCCION
II.- SISTEMAS NUMERICOS
III.- ALGEBRA BOOLEANA
IV.- CODIGO Y REPRESENTACION DE INFORMACION
V.- MINIMINIZACION DE FUNCIONES BOOLEANAS
VI.- DISEÑO CONBINACIONAL
VII.- FLIP FLOPS (ELEMENTOS DE MEMORIA)
VIII.- DISEÑO SECUNCIAL
IX.- FAMILIAS LOGICAS

TEXTO ÷ FUNDAMENTOS DE DISEÑO DIGITAL

AUTOR INGENIERO CESAR LEAL CHAPA

ALUMNO. MARTHA PATRICIA RAZO CRUZ

MATRICULA. 386980

HORA. V-6

* SISTEMAS NUMERICOS *

NUMEROS ROMANOS

I - 1	C - 100		
V - 5	D - 500		
X - 10	M - 1000		
L - 50			

SISTEMA NUMERICO DECIMAL

0	4	8
1	5	9
2	6	
3	7	

FORMULA GENERAL

$$N = \sum_{i=0}^{i=n-1} a R^i$$

N = CANTIDAD
i = POSICION
a = COEFICIENTE
n = NUMERO DE DIGITOS
R = RAIZ O BASE DEL SISTEMA

BINARIO

0, 1

OCTAGONAL

0, 1, 2, 3, 4, 5
6, 7

HEXADECIMAL

0, 1, 2, 3, 4, 5
6, 7, 8, 9, A, B,
C, D, 6, F.

EJEMPLO 529(10)

$N = 9(10)^0 + 2(10)^1 + 5(10)^2 \rightarrow 9 + 20 + 500$

$N = 529$ *

N(10)	N(2)	N(8)	N(16)	N(3)
0	0000	0	0	0
1	0001	1	1	1
2	0010	2	2	2
3	0011	3	3	10
4	0100	4	4	11
5	0101	5	5	12
6	0110	6	6	20
7	0111	7	7	21
8	1000	10	8	22
9	1001	11	9	100
10	1010	12	A	101
11	1011	13	B	102
12	1100	14	C	110
13	1101	15	D	111
14	1110	16	E	112
15	1111	17	F	120
16	1000	20	10	121

* CONVERSIONES *

$N(x) \rightarrow N(10)$
- a) FORMULA GENERAL $N(10) = \sum_{i=0}^{i=N-1} aR^i$
- b) MULTIPLICAR POR LA BASE Y SUMAR

$N(10) \rightarrow N(x)$
- a) EXTRACION DE POTENCIAS
- b) RESIDUOS

$N(2) \leftrightarrow N(8)$ } MULTIPLO
$N(2) \leftrightarrow N(16)$ }

EJEMPLOS:

① $N(2) \rightarrow N(10)$

* $N(x) \rightarrow N(10)$ *

a) FORMULA GENERAL $10111011(2) = N(10)$

MSB ↗ ↘ LSB

$$N(10) = \sum_{i=0}^{i=n-1} aR^i$$

$$N(10) = 1(2)^0 + 1(2)^1 + 0(2)^2 + 1(2)^3 + 1(2)^4 + 1(2)^5 + 1(2)^6 + 1(2)^7$$

BIT = DIGITO BINARIO $N(10) = 1 + 2 + 8 + 16 + 32 + 128 = 187$

BYNARY DIGIL $N(10) = 187$

LSB = BIT DE MENOR PESO $10111011(2) \Rightarrow 187(10)$ *

MSB = BIT DE MAYOR PESO

② $N(8) \rightarrow N(10)$

$27.32(8) \rightarrow N(10)$

$N(10) = 2(8)^1 + 7(8)^0 + 3(8)^{-1} + 2(8)^{-2}$

$N(10) = 16 + 7 + 3/8 + 2/64$

$N(10) = 23.40625$

$27.32(8) = 23.40625(10)$ *

③ $N(16) \rightarrow N(10)$

$ABD(16) = N(10)$

$A = 10$

$B = 11$ $N(10) = 10(16)^2 + 11(16)^1 + 13(16)^0$

$C = 12$ $N(10) = 2560 + 176 + 13$

$D = 13$ $N(10) = 2749$

$E = 14$ $2749(10) = ABD(10)$ *

$F = 15$

④ $N(9) \rightarrow N(10)$ $N(10) = 3(9)^2 + 7(9)^1 + 6(9)^0 \rightarrow 243 + 63 + 6$

$N(10) = 312$

$376(9) \Rightarrow N(10)$ $312(10) = 376(9)$ *

* $N(x) \rightarrow N(10)$ *

b).- MULTIPLICAR POR LA BASE Y SUMAR: ESTE METODO CONSISTE EN MULTIPLICAR EL (MSB) POR LA BASE Y EL PRODUCTO RESULTANTE SUMARLO CON EL BIT SIGUIENTE A LA DERECHA, EL RESULTADO SE MULTIPLICA DE NUEVO POR LA BASE Y SE SUMA CON EL BIT O DIGITO SIGUIENTE Y ASI SUCESIVAMENTE HASTA LLEGAR AL (LSB) EL RESULTADO DE TODAS ESAS OPERACIONES RESULTA SER EL EQUIVALENTE DECIMAL.

EJEMPLO:

① $N(2) = N(10)$

$10111011(2) = N(10)$

$1(2) + 0 = 2$ $23(2) + 0 = 46$

$2(2) + 1 = 5$ $46(2) + 1 = 93$

$5(2) + 1 = 11$ $93(2) + 1 = 187$

$11(2) + 1 = 11$ $187(10) = 10111011(2)$ *

② $N(8) \rightarrow N(10)$

$325(8) = 213(10)$

④ $N(16) \rightarrow N(10)$

$A2C(16) \rightarrow 2604(10)$

③ $N(9) \rightarrow N(10)$

$347(9) = 286(10)$

BINARIO HEXADECIMAL

* $N(10) \rightarrow N(x)$ *

a).- EXTRACCION DE POTENCIAS

①

$35(10) \Rightarrow N(8)$

$8^0 = 1$
$8^1 = 8$
$8^2 = 64$

36
−8 → 8^1
27
−8 → 8^1
19
−8 → 8^1
11
−8 → 8^1
3
−3 VECES $8^0 \rightarrow 3^0$
0

(4 veces 8^1: 4^1)

$36(10) = 43(8)$ *

②

$467(10) = N(6)$

467 ⌊6
(5) 93 ⌊6
LSB (3) 18 ⌊6
(3) (3)
MSB

$467(10) = 3332(6)$ *

③

$35(10) = N(2)$

35 ⌊2
(1) 17 ⌊2
(1) 8 ⌊2
(0) 4 ⌊2
(0) 2 ⌊2
(0) 1

$35(10) = 100011(2)$ *

④

$35(10) - N(16)$

35 ⌊16
3 2
←

$33(16) = 35(10)$ *

⑤

$187(10) - N(16)$

187 ⌊16
11 11
←

$BB(16) = 187(10)$ *

⑥

$N(8) \rightarrow N(10)$

$273(8) \rightarrow N(10)$

$273(8) = 187(10)$

$N(x) \rightarrow N(10) \Rightarrow$ MULTIPLICAR POR LA BASE Y SUMAR

$N(10) \rightarrow N(x) \rightarrow$ RESIDUOS

$N(x) \rightarrow N(y)$
$N(2) \rightarrow N(8)$ } MULTIPLO
$N(2) \rightarrow N(16)$

* CADA TRES BITS CONVERTIDOS A DECIMALES FORMAN UN DIGITO EN OCTAL

$101\,100\,011\,010\,(2) \rightarrow N(8)$
5 4 3 2 (8)

2 0 5 (8)
↓ ↓ ↓
10 000 101

2	1	0
Z	Y	X
4	2	1

③

$1010\,111\,111\,101_{(2)} = N_{(8)}$

$1\ 2\ 7\ 7\ 5\ _{(8)}$

④

$6\ 2\ 1\ 5_{(8)} = N_{(2)}$

$110\,010\,001\,101_{(2)}$

* PARA 4 BIT CONVERTIDOS A DECIMAL REPRESENTAN UN DIGITO EN HEXADECIMAL. EJEMPLOS:

①

$1001\,1010\,1101\,0010_{(2)} = N_{(16)}$

$9\ A\ D\ 2\ _{(16)}$

③

$2\ 4\ F\ 3_{(16)} = N_{(8)}$

$0010\ 1010\ 1111\ 0011_{(2)}$

$0010\,1010\,1111\,0011_{(2)}$

$2\ 5\ 3\ 6\ 3\ _{(8)}$

②

$2\ A\ 7\ 3\ F\ C_{(16)} = N_{(2)}$

$0010\ 1010\ 0111\ 0011\ 1111\ 1100_{(2)}$

* SUMA *

$$\begin{array}{r} 297_{(10)} \\ +\ 345_{(10)} \\ \hline 642_{(10)} \end{array}$$

$$\begin{array}{r} 101111_{(2)} \\ +\ 101011_{(2)} \\ \hline 1010010_{(2)} \end{array}$$

$$\begin{array}{r} 1111_{(2)} \\ 1011_{(2)} \\ 1110_{(2)} \\ +\ 1110_{(2)} \\ 111_{(2)} \\ 1011_{(2)} \\ \hline 111010_{(2)} \end{array}$$

$$\begin{array}{r} 111111_{(2)} \\ 111111_{(2)} \\ +\ 111111_{(2)} \\ 101111_{(2)} \\ 101100_{(2)} \\ \hline 1000101110_{(2)} \end{array}$$

$$\begin{array}{r} 2374_{(8)} \\ +\ 6546_{(8)} \\ \hline 11442_{(2)} \end{array}$$

$$\begin{array}{r} 3765_{(8)} \\ +\ 2174_{(8)} \\ \hline 66740_{(8)} \end{array}$$

$$\begin{array}{r} ABC2F_{(16)} \\ +\ 15470_{(16)} \\ \hline 210AB \end{array}$$

* RESTO *

a).- NATURAL

b).- PRESTAMO (BORROW)

MINUENDO
- SUSTRAENDO
DIFERENCIA

$$\begin{array}{r} 712_{(10)} \\ -\ 593_{(10)} \\ \hline 019_{(10)} \end{array}$$

$$\begin{array}{r} 101100_{(2)} \\ -\ 011011_{(2)} \\ \hline 001111_{(2)} \end{array}$$

$$\begin{array}{r} 101100_{(2)} \\ -\ 11101 \\ \hline 01111_{(2)} \end{array}$$

100110110 (2)	101100010 (2)	62806 (8)	60021 (8)
- 11001111 (2)	- 11111111 (2)	- 7774 (8)	- 7774 (8)
099808999	011100001 (2)	50025 (8)	50025 (8)
11101011			

62305 (8)	27302 (8)	F0201 (16)
- 33156 (8)	- 17402 (8)	- ABDF (16)
27127 (8)	07700 (8)	85622 (16)

* ALGEBRA BOOLEANA (GEORGE BOOLE)

$A = \begin{cases} 0 \; A' \\ 1 \; A \end{cases}$

Nº DE COMBINACIONES = 8^N

N ⇒ NUMERO DE VARIABLES

* TABLAS DE VERDAD *

ENTRADA	SALIDA
A	S
0	?
1	

M	A	B	S
0	0	0	
0	0	1	
3	1	1	

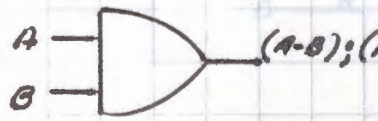
M	A	B	C
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

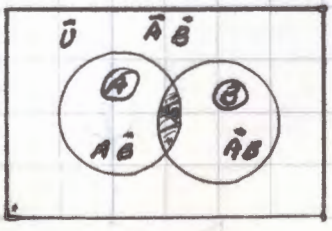
OPERADORES

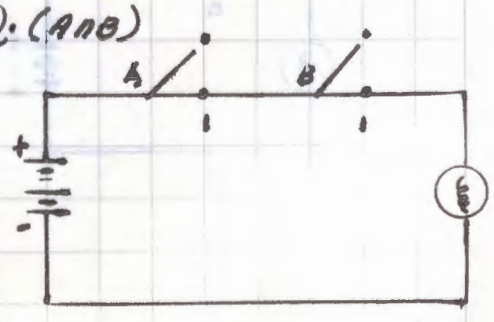
(AND) * Y *

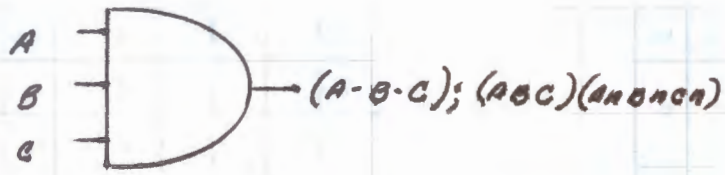
"CONDICION" "SIMBOLO"

A	B	A · B
0	0	0
0	1	0
1	0	0
1	1	1







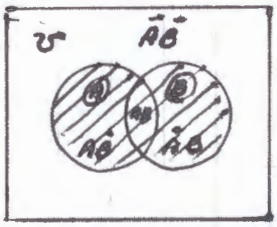


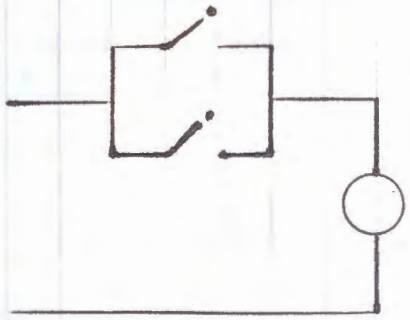
M	A	B	C	(A·B·C)(ABC)(ANOTHER)
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	0
4	1	0	0	0
5	1	0	1	0
6	1	1	0	0
7	1	1	1	1

(OR) * o *

"ALTERNATIVA" "SIMBOLO" "CIRCUITO ELECTRICO EQUIVALENTE"

M	A	B	S
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	1

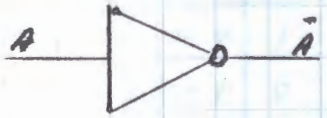


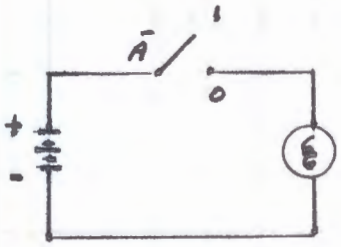


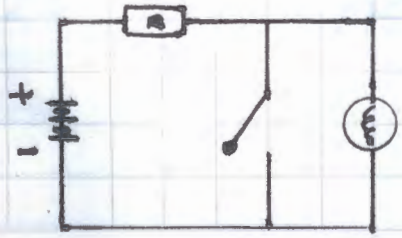
(NOT) * NEGAR *

"SIMBOLO" "CIRCUITO ELECTRICO EQUIVALENTE"

A	$\bar{A}$
0	1
1	0



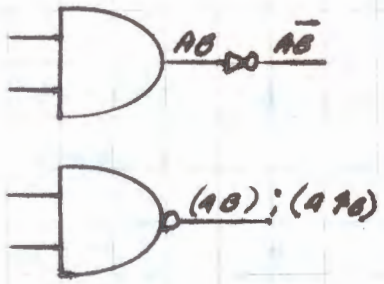




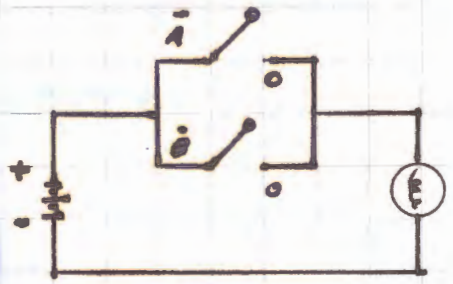
			AND	OR
M	A	B		
0	0	0	0	0
1	0	1	0	1
2	1	0	0	1
3	1	1	1	1

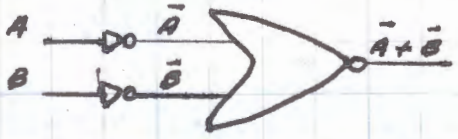
		NOT
M	A	
0	0	1
1	1	0

(NAND) * NO-AND * * TABLA DE VERDAD * CIRCUITO ELECTRICO EQUIVALENTE

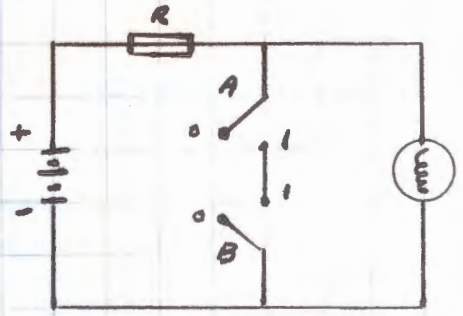


M	A	B	A↑B
0	0	0	1
1	0	1	1
2	1	0	1
3	1	1	0



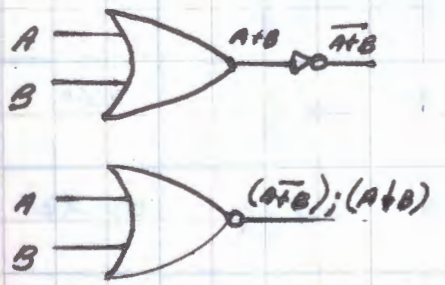


$\bar{A}+\bar{B} = A \uparrow B$

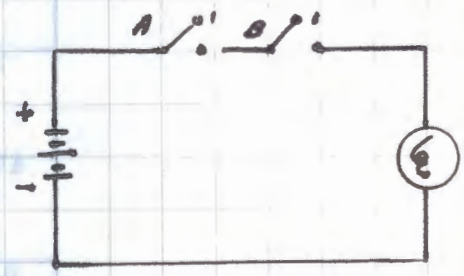


(NOR)

"SIMBOLO" * TABLA DE VERDAD * * CIRCUITO ELECTRICO EQUIVALENTE *



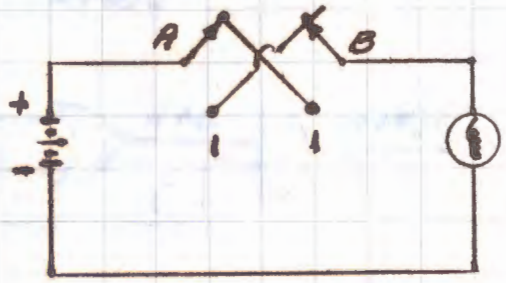
W	A	B	A+B
0	0	0	1
1	0	1	0
2	1	0	0
3	1	1	0



(EX-OR) OR-EXCLUSIVO: EL EX-OR ES VERDADERO CUANDO UN NUMERO IMPAR DE VARIABLES DE ENTRADAS SON VERDADERAS.

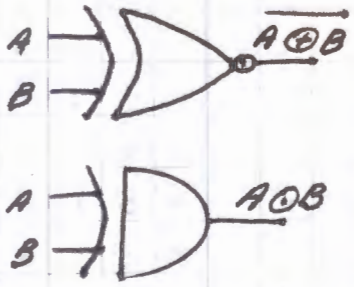
"SIMBOLO"

M	A	B	A⊕B
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	0

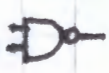
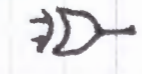
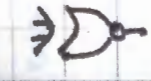
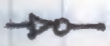


(EX-NOR) .' ✱ COINCIDENCE = AND-COINCIDENCE ✱

"SIMBOLO"

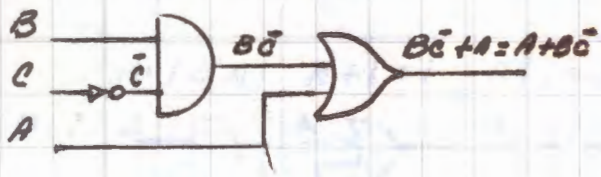


A	A	B	A⊙B
0	0	0	1
1	0	1	0
2	1	0	0
3	1	1	1

NOMBRE	SIMBOLO	EXPRESION	TABLA
AND		A B A·B	AB | AB 00 | 0 01 | 0 10 | 0 11 | 1
OR		A+B	AB | A+B 00 | 0 01 | 1 10 | 1 11 | 1
NAND		$(\overline{AB})$; $(\overline{A}\,\overline{B})$; (AND)	AB | A+B 00 | 1 01 | 1 10 | 1 11 | 0
NOR		$(\overline{A+B})$; (A+B)	AB | A+B 00 | 0 01 | 1 10 | 1 11 | 0
EX-OR		A ⊕ B	AB | A⊕B 00 | 0 01 | 1 10 | 1 11 | 0
EX-NOR COINCIDENCE		$(\overline{A \odot B})$; $(A \overline{\odot} B)$	AB | A⊙B 00 | 1 01 | 0 10 | 0 11 | 1
NOT		$\bar{A}$	A | Ā 0 | 1 1 | 0

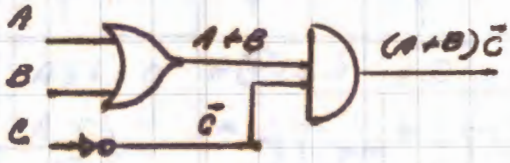
* EXPRESIONES BOOLEANAS *

a).- $A + B\bar{C}$



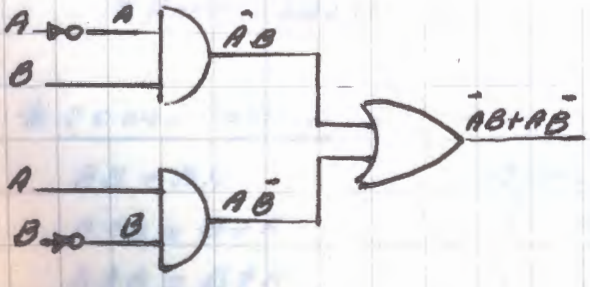
M	A	B	C	$A+B\bar{C}$
0	0	0	0	0
1	0	0	1	0
2	0	1	0	1
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

b).- $(A+B)\bar{C}$



M	A	B	C	$(A+B)\bar{C}$
0	0	0	0	0
1	0	0	1	0
2	0	1	0	1
3	0	1	1	0
4	1	0	0	1
5	1	0	1	0
6	1	1	0	1
7	1	1	1	0

a) $\bar{A}B + A\bar{B}$

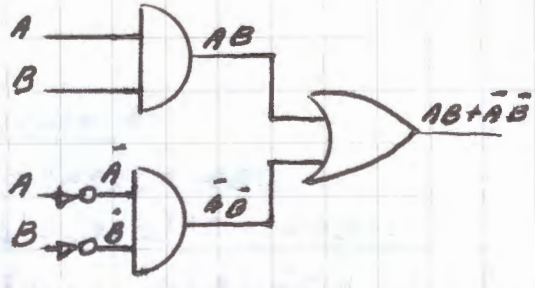


M	A	B	$\bar{A}B+A\bar{B}$
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	0

* SE COMPORTA COMO UN EX-OR

* $A\bar{B} + \bar{A}B = A \oplus B$ *

b).- $AB + \bar{A}\bar{B}$

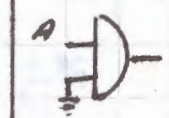
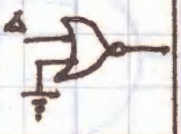
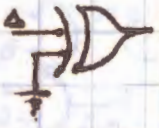
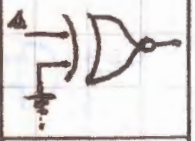
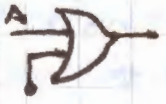
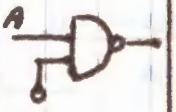
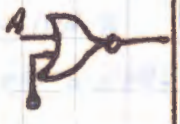
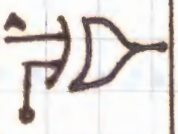
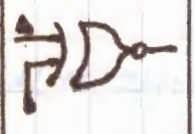
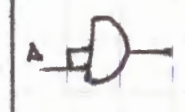
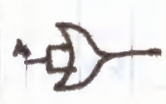
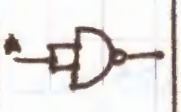
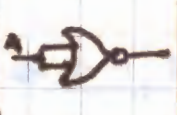
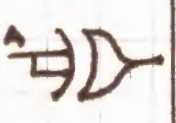
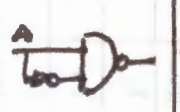
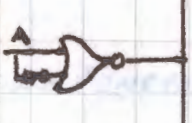
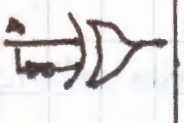
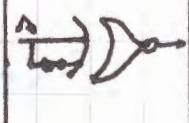


M	A	B	$AB+\bar{A}\bar{B}$
0	0	0	1
1	0	1	0
2	1	0	0
3	1	1	1

SE COMPORTA COMO UN EX-NOR

* $AB+\bar{A}\bar{B} = A \odot B$ *

IDENTIDADES

X Y	AND	OR	NAND	NOR	EX-OR	EX-NOR
0 0 1 0	$A \cdot 0 = 0$ 	$A+0=A$ 	$A \uparrow 0 = 1$ 	$A \downarrow 0 = \bar{A}$ 	$A \oplus 0 = A$ 	$\overline{A \oplus 0} = \bar{A}$ 
0 1 1 1	$A \cdot 1 = A$ 	$A+1=1$ 	$A \uparrow 1 = \bar{A}$ 	$A \downarrow 1 = 0$ 	$A \oplus 1 = \bar{A}$ 	$\overline{A \oplus 1} = \bar{A}$ 
0 0 1 1	$A \cdot A = A$ 	$A+A=A$ 	$A \uparrow A = \bar{A}$ 	$A \downarrow A = \bar{A}$ 	$A \oplus A = 0$ 	$\overline{A \oplus A} = 1$ 
0 1 1 0	$A \cdot \bar{A} = 0$ 	$A+\bar{A}=1$ 	$A \uparrow \bar{A} = 1$ 	$A \downarrow \bar{A} = 0$ 	$A \oplus \bar{A} = 1$ 	$A \oplus \bar{A} = 0$ 

NOT

$\bar{\bar{A}} = A$ 

* PROPIEDADES

* <u>COMULATIVA</u> *

$AB = BA$

$A+B = B+A$

$A \uparrow B = B \uparrow A$

$A \downarrow B = B \downarrow A$

$A \oplus B = B \oplus A$

$\overline{A \oplus B} = \overline{B \oplus A}$

* <u>ASOCIATIVA</u> *

$A(BC) = (AB)C = ABC$

$A+(B+C) = (A+B)+C = A+B+C$

$A \oplus (B \oplus C) = (A \oplus B) \oplus C = A \oplus B \oplus C$

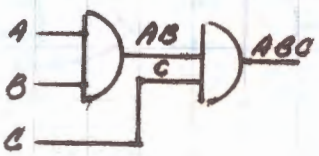
(NAND); (NOR); (EX-NOR)

$A \uparrow (B \uparrow C) \neq (A \uparrow B) \uparrow C \neq (A \uparrow B \uparrow C)$

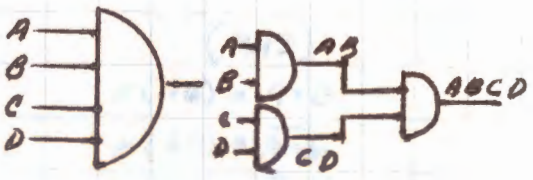
$A \downarrow (B \downarrow C) \neq (A \downarrow B) \downarrow C \neq (A \downarrow B \downarrow C)$

$A \odot (B \odot C) \neq (A \odot B) \odot C \neq A \odot B \odot C$

* PARA TRES ENTRADAS *



* PARA CUATRO ENTRADAS *



* PROPIEDAD DISTRIBUTIVA *

$\rightarrow A + BC = (A+B)(A+C) \rightarrow AA + AC + AB + BC = A + AC + BC + AB = A(1+C+B) + BC$

$\rightarrow A(1+B) + BC \rightarrow A(1) + BC \rightarrow \underline{A+BC}$ *

$\rightarrow A + \bar{A}C = (A+\bar{A})(A+C) = 1(A+C) \rightarrow \underline{A+C}$ *

* TEOREMA DE MORGAN *

"COMPLEMENTO INVERSO DE UNA FUNCION BOOLEANA"

REGLAS:

1.- SOLO PARA <u>EXPRESIONES NEGADAS</u>
2.- REEMPLAZAR TODOS LOS OPERADORES AND POR OR
3.- REEMPLAZAR TODOS LOS OPERADORES OR POR AND
4.- REEMPLAZAR TODAS LAS VARIABLES POR SO COMPLEMENTO
5.-

* (NAND) *

$F(\overline{AB}) = \bar{A} + \bar{B}$
$F(\overline{AB}) = \bar{A} \cdot \bar{B}$
$F(\overline{AB} = \bar{A} + \bar{B}$

NAND

OR

A	B	$\overline{A+B}$	$\bar{A}+\bar{B}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0

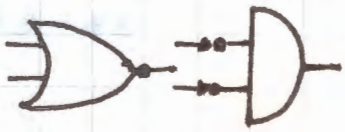
(NOR)

$F(AB) = A \downarrow B$

$F(AB) = \overline{A+B}$

$F(AB) = \bar{A} \cdot \bar{B}$

NOR = AND



(AND)

$F(AB) = A \cdot B$

$F(AB) = \overline{A \cdot B}$

$F(AB) = \bar{A} + \bar{B}$

$F(AB) = \overline{A+B}$

$F(AB) = \bar{A} \downarrow \bar{B}$

(OR)

$F(AB) = A + B$

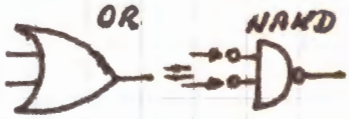
$F(AB) = \overline{A+B}$

$F(AB) = \bar{A} \cdot \bar{B}$

$F(AB) = A \cdot B$

$F(AB) = \bar{A} \uparrow \bar{B}$

OR NAND



AND $\Longleftrightarrow$ NOR

OR $\Longleftrightarrow$ NAND

"TEOREMA DE MORGAN EN EXPRESIONES"

(1)

$F(ABC) = \bar{A} + (\overline{BC}) =$

$F(ABC) = A \uparrow (\bar{B} \downarrow \bar{C})$

$F(ABC) = A \uparrow (\bar{B} + \bar{C})$

$F(ABC) = \bar{A} + (\bar{B} \downarrow \bar{C})$ *

IGUALES

(2)

$F(ABCD) = BC + (A \uparrow B \uparrow D)$

$F(ABCD) = BC + (\bar{A} + \bar{B} + \bar{D})$

$F(ABCD) = \overline{BC} + (\bar{A} + \bar{B} + \bar{D})$

$F(ABCD) = (\bar{B} + \bar{C}) \uparrow (\bar{A} \downarrow \bar{B} \downarrow \bar{D})$ *

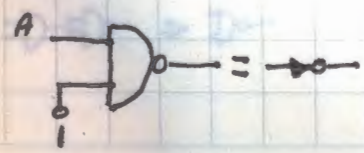
* SUBTITUCIÓN DE EXPRESIONES BOOLEANAS POR:

1. – NAND'S
2. – NOR'S

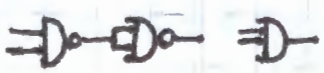
1) a) NOR a PARTIR NAND'S

$A \uparrow A = \bar{A}$

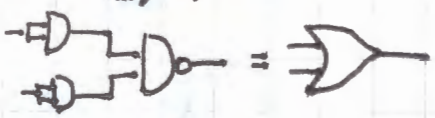
$A \uparrow 1 = A$



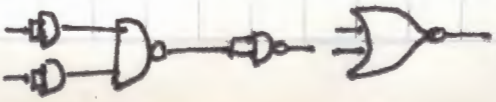
1) b) AND



1) c) OR

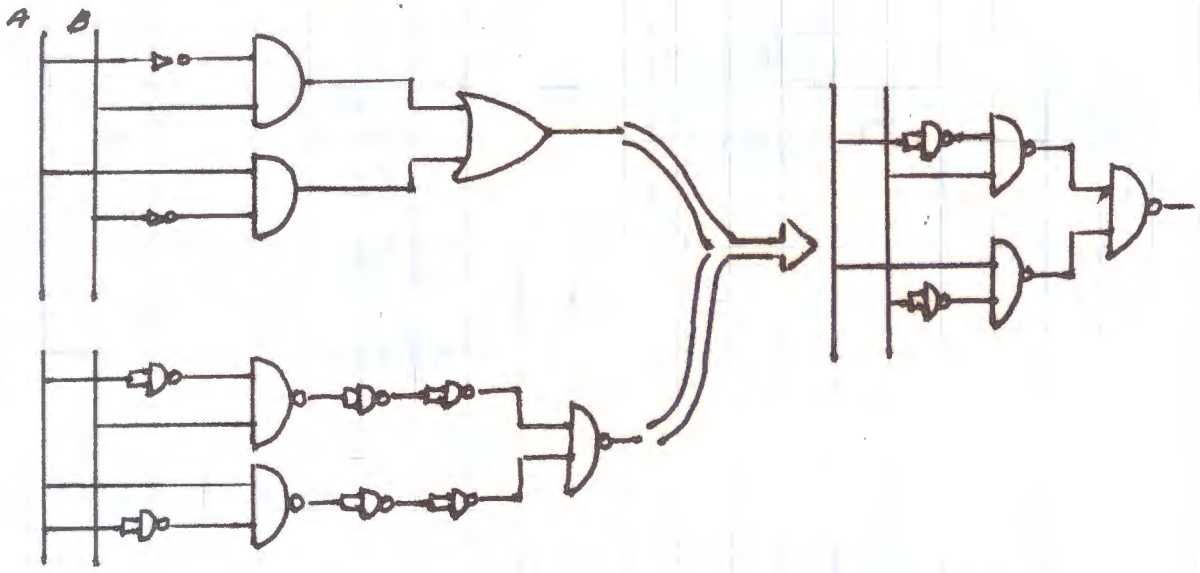


1) d) NOR

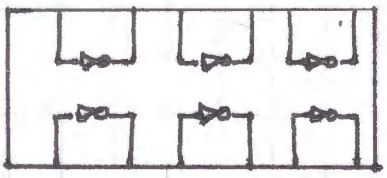


1).- G) EX NOR

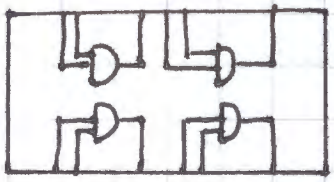
$A \oplus B = \bar{A}B + A\bar{B}$



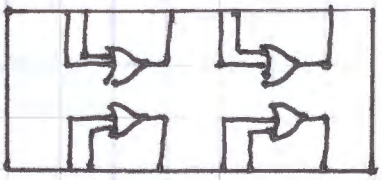
UN CHIP DE (NOT) SN 7404 2/6 33%



UN CHIP DE (AND) SN 7408 3/4 50%

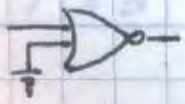


UN CHIP DE (OR) SN 7432 1/4 25%



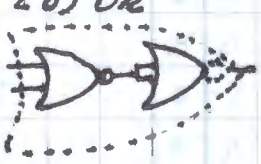
* SUSTITUCION DE COMPONENTES POR (NOR'S)

2a) NOT

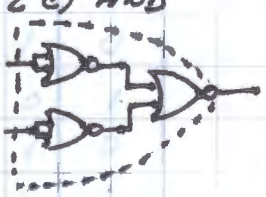


A + A

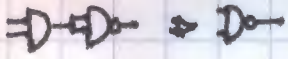
2b) OR



2c) AND



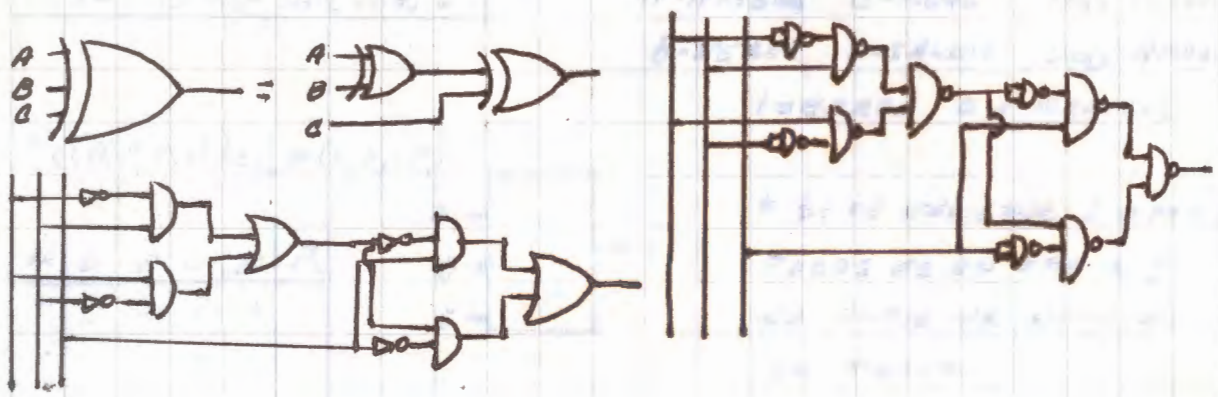
2d) NAND



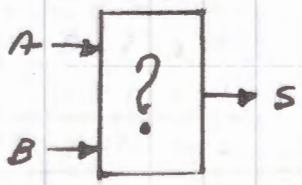
2e) EX-OR

$A \oplus B \oplus C$

REEMPLAZAR UN (EX-OR) DE TRES ENTRADAS POR COMPUERTAS NAND'S DE DOS ENTRADAS



* MINITERMINO *



A	B	S	S_1	S_2	S_3
0	0	0	0	0	1
0	1	1	0	0	0
1	0	0	0	1	0
1	1	0	1	0	0

A	B	MINI
0	0	$\bar{A}\bar{B}$
0	1	$\bar{A}B$
1	0	$A\bar{B}$
1	1	AB

A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

$F(AB) = \bar{A}B + A\bar{B}$

M	A	B	C	F_2
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	0
6	1	1	0	1
7	1	1	1	0

$F_1(ABC) = \bar{A}\bar{B}C + \bar{A}B\bar{C} + AB\bar{C}$

FORMA CANONICA

$F_1(ABC) = M_1 + M_4 + M_6$

$F_1(ABC) = \sum M(1,4,6)$ *

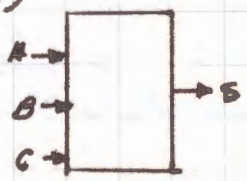
DETECTOR DE ERRORES DE UN SEMAFORO

A-AMBAR C-ROJO 1 ⇒ ENCENDIDO

B-VERDE S-SALIDA 0 ⇒ APAGADO

1 = ERROR 0 = NORMAL

$F_2(D,A,C,B) = \sum M(0,3,15)$



* SI SE ENCIENDE 2 O MAS FOCOS ES UN ERROR Y SI NO ENCIENDE NINGUNO ES UN ERROR

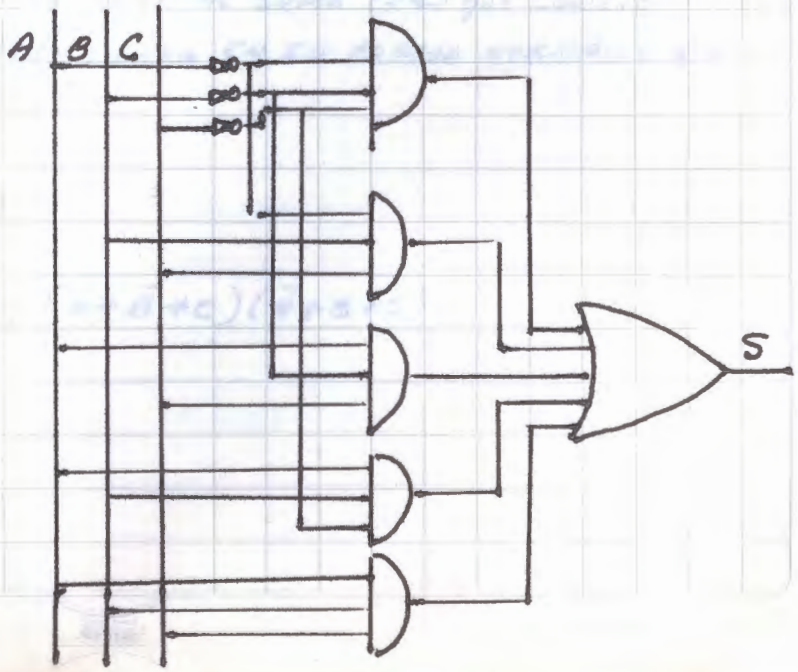
M	D	A	C	B	F_2
0	0	0	0	0	1
1	0	0	0	1	0
2	0	0	1	0	0
3	0	0	1	1	1
4	0	1	0	0	0
5	0	1	0	1	0
6	0	1	1	0	0
7	0	1	1	1	0
8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	1	0	0
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	0
15	1	1	1	1	1

M	A	B	C	S
0	0	0	0	1
1	0	0	1	0
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

* MINITERMINO ES AQUEL DONDE LA SALIDA VALE (1)

$F_1(ABC) = \bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$

$F_2(ABC) \Rightarrow \sum m(0,3,5,6,7)$



M	A	B	C	S	$\bar{S}$
0	0	0	0	1	0
1	0	0	1	0	1
2	0	1	0	0	1
3	0	1	1	1	0
4	1	0	0	0	1
5	1	0	1	1	0
6	1	1	0	1	0
7	1	1	1	1	0

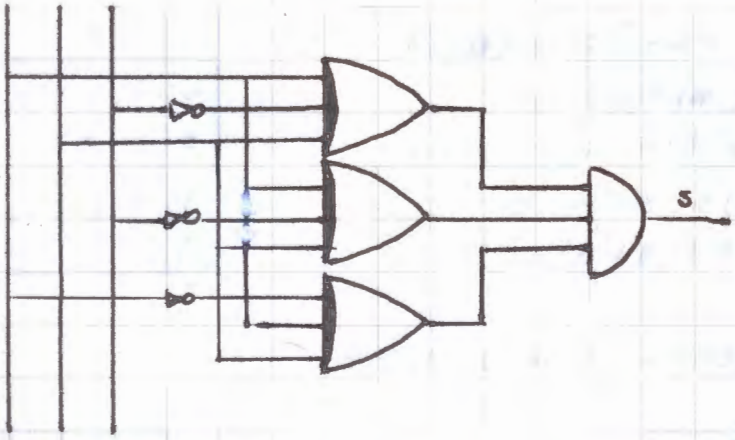
$\bar{S}(ABC) = \sum m(1,2,3)$

$\bar{S}(ABC) = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C}$

$\bar{\bar{S}}(ABC) = (\bar{A}\bar{B}C) + (\bar{A}B\bar{C}) + (A\bar{B}\bar{C})$

$S(ABC) = (A+B+\bar{C}).(A+\bar{B}+\bar{C}).(\bar{A}+B+C)$ *

$\bar{F}$ COMO ALTERNATIVA "MAXITERMINOS" OR/AND



"MAXITERMINO" ⇒ ES UN TERMINO SUMA (OR) QUE CONTIENE TODAS LAS VARIABLES DE LA FUNCION YA SEA EN SU FORMA NORMAL O EN SU FORMA IMPLEMENTADA.

$F_S(ABC) = \sum n(1,2,3)$

$F_S(ABC) = (A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+C)$

W/i	A	X	Y	F_1	F_2
0	0	0	0	0	0
1	0	0	1	1	1
2	0	1	0	1	0
3	0	1	1	0	0
4	1	0	0	0	0
5	1	0	1	1	1
6	1	1	0	1	0
7	1	1	1	0	0

$F(AXY) = \sum (1,2,5,6)$

$F(AXY) = \bar{A}\bar{X}Y + \bar{A}X\bar{Y} + A\bar{X}Y + AX\bar{Y}$

$F(AXY) = \sum_{\pi} (1,3)$

F_1 { $F \in m$; SOD ; $F \in \pi$; POS } F_2 { ? }

M	A	B	F
0	0	0	0
1	0	1	0
2	1	0	1
3	1	1	1

$F(AB) = A\bar{B} + AB$ AND/OR

$= \overline{(A\bar{B})} \uparrow \overline{(AB)}$ NAND/AND

$= (\bar{A}+B) \uparrow (\bar{A}+\bar{B})$ OR/NAND

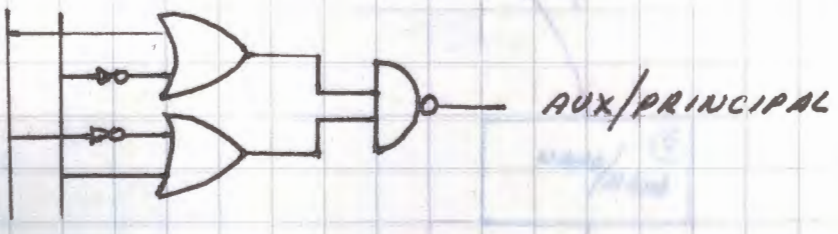
$= (\bar{A} \downarrow B) + (\bar{A} \downarrow \bar{B})$ NOR/OR

$= (\bar{A}+B)(A+\bar{B})$ OR/AND

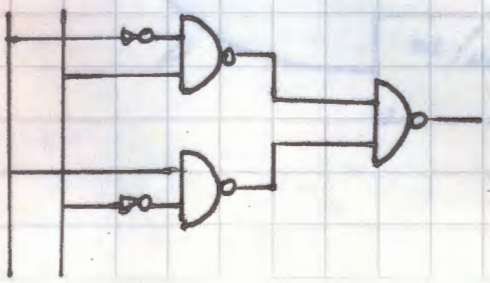
* LAS OCHO FORMULAS STANDARD *

M	A	B	F
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	0

$F(AB) = \bar{A}B + A\bar{B}$ AND/OR



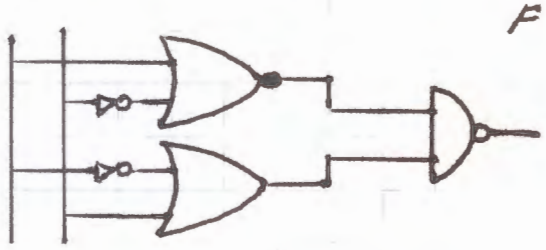
PARA OBTENER LA SEGUNDA STANDARD SE APLICARA EL TEOREMA DE MORGAN A LA COMPUERTA PRINCIPAL DE LA PRIMERA FORMA STANDARD



$F(AB) = \overline{\bar{A}B} \uparrow \overline{A\bar{B}}$ NAND/NAND

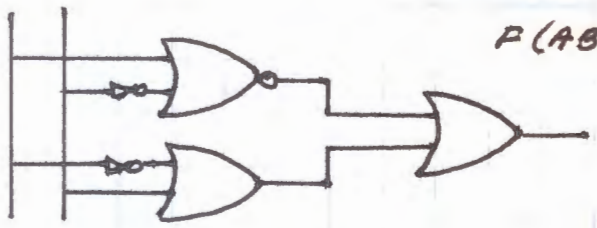
LA TERCER FORMA STANDARD SE OBTIENE A PARTIR DE LA SEGUNDA, APLICANDO EL TEOREMA DE MORGAN A LOS AUXILIARES (NAND'S)

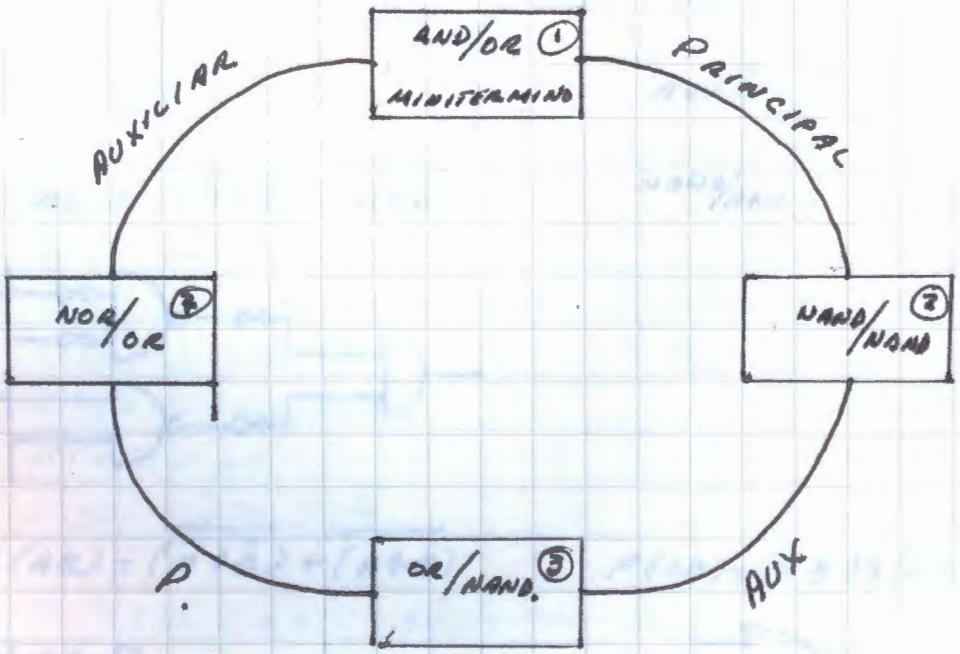
$$F(AB) = (\overline{A+\bar{B}}) + (\overline{\bar{A}+B})$$ NOR/NAND

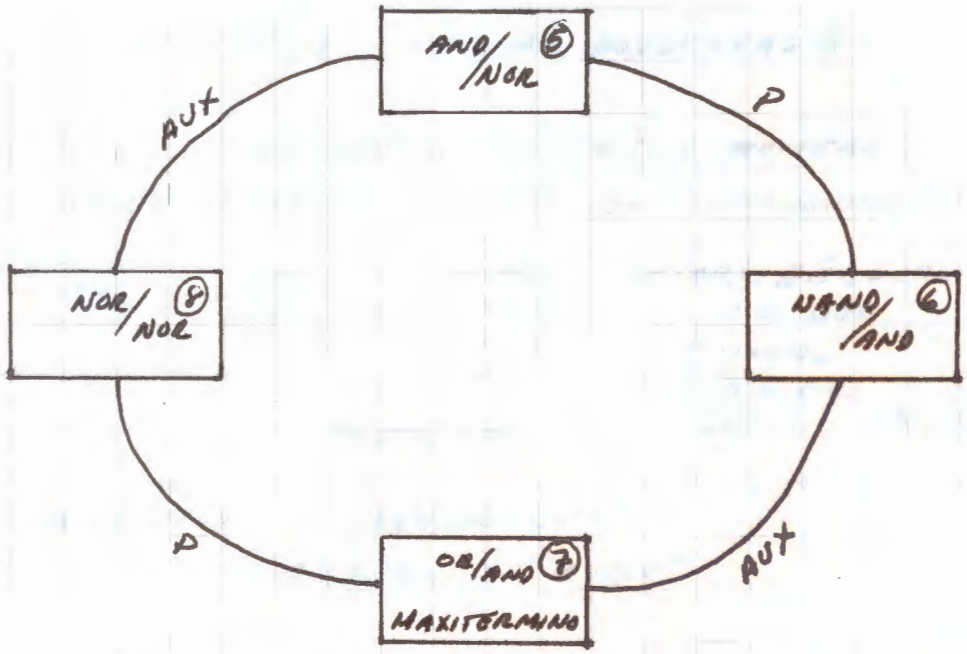


LA CUARTA FORMA SE OBTIENE A PARTIR DE LA TERCERA APLICANDO EL TEOREMA DE MORGAN EN LA PRINCIPAL (NAND)

$$F(AB) = (\overline{A+\bar{B}}) + (\overline{\bar{A}+B})$$ NOR/OR

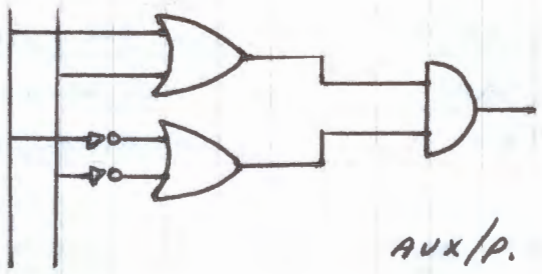






$F(A\,B) = (A+B)(\bar{A}+\bar{B})$ OR/AND.

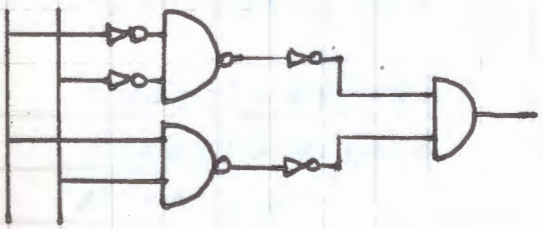
M	A	B	
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	0



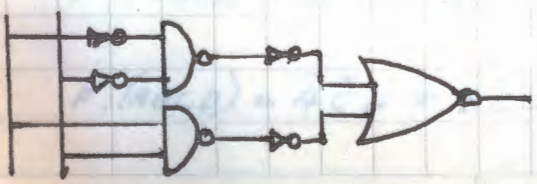
AUX/P.

$F(AB) = \overline{(A+B)} \cdot \overline{(\bar{A}+\bar{B})}$.

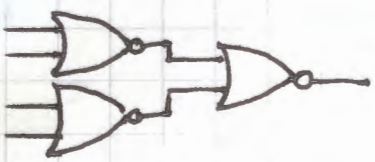
NAND/AND



$F(AB) = \overline{(\bar{A}+\bar{B})} + \overline{(A+B)}$

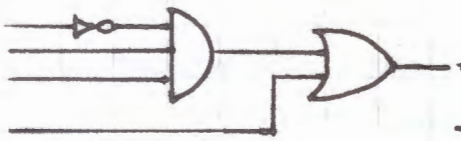


$F(AB) = (\bar{A}\bar{B}) \downarrow (AB) \downarrow (\bar{A}+\bar{B}) \downarrow (A \downarrow B)$



* MINIMIZACION DE FUNCIONES BOOLEANAS *

(COST UNIT. (COSTO UNITARIO) "C.U." = ES EL NUMERO DE ENTRADAS O SUMA DE ENTRADAS DE TODOS LOS COMPONENTES DEL CIRCUITO



1 → NOT
+ 3 + AND
2 + OR
6
COST UNIT = 6

$F(AB) = A\bar{B}C + \bar{A}\bar{B}C + ABC$
2 → NOT
+ 9 AND
3 → OR
14 COST. UNIT. 14

a) MANIPULACION ALGEBRAICA
b) MAPAS DE KARGAUGH Ó "KMAP"

a) 1.- FACTORIZACION
2.- DUPLICADO UN TERMINO YA EXISTENTE
3.- MULTIPLICANDO POR UN FACTOR DE LA FORMA $(a+\bar{a})=1$
4.- PROPIEDAD DISTRIBUTIVA.

1.- $F(AB) = \bar{A}\bar{B} + \bar{A}B$
$F(AB) = \bar{A}(\bar{B}+B)$
$F(AB) = \bar{A}$
COST. UNIT. = 1 *

$F_1(ABC) = ABC + A\bar{B}C$
$F(ABC) = AC(B+\bar{B})$
$F(AB) = AC$
COST. UNIT. 2 *

$F_2(ABCD) = \bar{A}\bar{B}\bar{C}D + A\bar{B}\bar{C}D + \bar{A}B\bar{C}D + \bar{A}\bar{B}\bar{C}D$

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

2.- $F(AB) = \bar{A}\bar{B} + \bar{A}B + A\bar{B} + \bar{A}\bar{B}$
$F(AB) = \bar{A} + \bar{B}$ *

$F(ABC) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC + ABC$
$F(ABC) = \bar{A}\bar{B} + \bar{A}B + BC$
$F(ABC) = \bar{A} + BC$ *

3.- MULTIPLICANDO POR UN FACTOR DE LA FORMA $(a+\bar{a})$

$F_1(xyz) = xz + \bar{x}y + yz$ CN=10
$F_2(xyz) = xz + \bar{x}y + yz(x+\bar{x})$
$= xz + \bar{x}y + xyz + \bar{x}yz$
$= xz(1+y) + \bar{x}y(1+z)$
$= xz + \bar{x}y$ * C.U.= 7

PROPIEDAD DISTRIBUTIVO

$a+bc = (a+b)(a+c)$

$a+\bar{a}c = (a+a)'(a+c)$

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

$F(ABC) = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}B\bar{C} + \bar{A}BC + ABC$

$F(ABC) = \bar{A}\bar{B} + \bar{A}B + BC$

$F(ABC) = \underline{\bar{A} + BC}\,|\,*$

$F.(ABC) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$

$A + \bar{A} = 1$

$AB + \bar{A}\bar{B} \neq 1$

$ABC + \bar{A}\bar{B}\bar{C} \neq 1$

} NO SON IGUALES A 1

$F(ABC) = \bar{A}\bar{B} + B\bar{C} + A\bar{B} + AB$

$F(ABC) = \bar{B} + B\bar{C} + A$

$F(ABC) = (\bar{B}+B)^3(\bar{B}+\bar{C}) + A.$

$F(ABC) = \underline{B + C + A}\,|\,*$ C.U.: 5

$\underline{\bar{A}\bar{B} + \bar{A}B} + \underline{A\bar{B} + AB} = 1$

$\bar{A} + A = 1$

$F_1(ABCD) = \sum_m (0, 4, 5, 7, 8, 12, 13, 15)$

$F_2(xy) = xy(x+y)$

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

$F_4(ABCDE) = (A+B)(A+C)(A+D)(A+E)$

$F_1(ABCD) = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + AB\bar{C}\bar{D} + A\bar{B}\bar{C}D + ABCD$

$= \bar{A}\bar{C}\bar{D} + \bar{A}BD + A\bar{C}\bar{D} + ABD$

$= \underline{\bar{C}\bar{D} + BD}\,|\,*$ C.U. = 7

$F_2(xy) = xy(x+y)$

$= xxy + xyy$

$= xy + xy$

$= xy(1+1)$

$= \underline{xy}\,|\,*$

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

$= \underline{\bar{A}\bar{B} + AB}\,|\,*$

$F_4 = (ABCDE)(A+B)(A+C)(A+D)(A+E)$

$F_4 = (ABCDE) = (A+AC+AB+BC)(A+D)(A+E)$

$= [A(1+C+B)' + BC](A+D)(A+E)$

$= (A+BC)(A+D)(A+E)$

$= (A+AD+ABC+BCD)(A+E)$

$= [A(1+D+BC)+BCD](A+C)$

$= (A+BCD)(A+E)$

$= \underline{A+BCDE}$ *

EJEMPLO:

REPRESENTAR EN UNA FUNSION BOOLEANA UN SISTEMA DE CONTROL DE CALIDAD EN UNA FABRICA.

A LAS PIEZAS QUE SE PRODUCEN SE VERIFICAN SUS CARACTERISTICAS DE MODO QUE CUANDO LA FUNSION ES VERDADERA ESTE INDICA QUE LA PIEZA ES DEFECTUOSA.

LAS CARACTERISTICAS A COMPROBAR SON: LONGITUD, PESO, ACABADO Y RESISTENCIA.

SE DICE QUE UNA PIEZA ES DEFECTUOSA CUANDO CUMPLE CON CUALQUIERA DE LAS SIGUIENTES CONDICIONES.

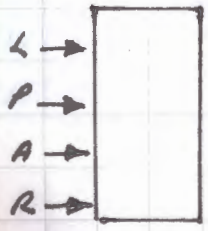
a). - LA PIEZA TIENE MAL ACABADO CON BUENA RESISTENCIA.

b). - LA LONGITUD ES ADECUADA PERO EL PESO Y EL ACABADO SON MALOS.

c). - LA LONGITUD ES ADECUADA, EL ACABADO Y LA RESISTECIA SON MALOS Y EL PESO ADECUADO.

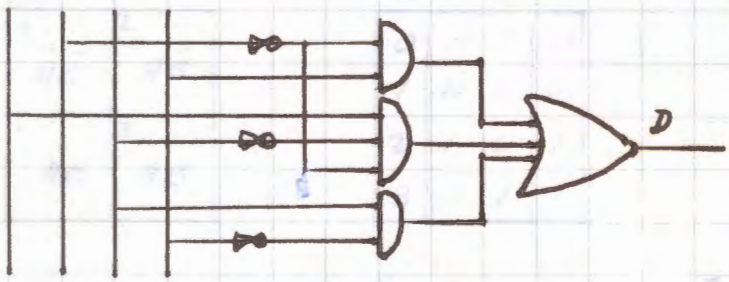
d). - LONGITUD, ACABADO Y PESO ADECUADO, PERO MALA RESISTENCIA

e). - PESO ADECUADO, PERO LONGITUD Y RESISTENCIA MALAS.



		NO	SI	
LONGITUD	(L)	0	1	ADECUADA
PESO	(P)	0	1	
ACABADO	(A)	0	1	
RESISTENCIA	(R)	0	1	
DEFECTUOSOS	(D)	0		

$$F(LPAR) = \bar{A}R + L\bar{P}\bar{A} + L\bar{A}\bar{R}P + LAP\bar{R} + PL\bar{R}$$
$$= \bar{A}R + L\bar{P}\bar{A} + L\bar{R}P + PL\bar{R}$$
$$= \underline{\bar{A}R + L\bar{P}\bar{A} + PL\bar{R}} \ *$$



MINITERMINOS

M	L	A	P	R	D
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	1
4	0	1	0	0	0
5	0	1	0	1	0
6	0	1	1	0	1
7	0	1	1	1	0
8	1	0	0	0	1
9	1	0	0	1	1
10	1	0	1	0	1
11	1	0	1	1	1
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	1
15	1	1	1	1	0

$$F(LAPR) = \underbrace{\bar{L}\bar{A}\bar{P}\bar{R}}_{0} + \underbrace{\bar{L}\bar{A}\bar{P}R}_{1} + \underbrace{\bar{L}\bar{A}P\bar{R}}_{2} + \underbrace{\bar{L}APR}_{3} + \underbrace{L\bar{A}\bar{P}\bar{R}}_{4} + \underbrace{L\bar{A}PR}_{5} + \underbrace{LA\bar{P}\bar{R}}_{6} + \underbrace{LA\bar{P}R}_{7} + \underbrace{LAP\bar{R}}_{8} + \underbrace{LAPR}_{9}$$

$$F(LAPR) = \bar{L}\bar{A}\bar{P}\bar{R} + \bar{L}\bar{A}\bar{P} + \underbrace{L\bar{A}\bar{P}}_{1} + APR + \underbrace{L\bar{A}P}_{1}$$

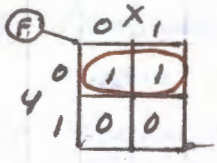
$$F(LAPR) = L\bar{A} + L\bar{A} + APR$$

$$F(LAPR) = \underline{L\bar{A} + APR} \ *$$

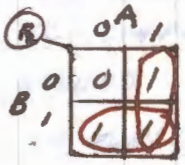
REGLAS PARA EL USO DEL MAPA DE KARNAUG

1.- FORMAR LA MENOR CANTIDAD DE GRUPOS
2.- CADA GRUPO CON LA MAYOR CANTIDAD DE UNOS (1)
3.- EL NUMERO DE UNOS QUE FORMAN UN GRUPO DEBE SER UNA CANTIDAD IGUAL O UNA POTENCIA ENTERA DE DOS (1, 2, 4, 8, 16 ETC.)

* GRUPOS TIPICOS DE DOS (2)

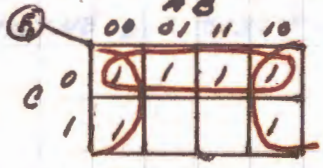


$F_1 = \bar{y}$

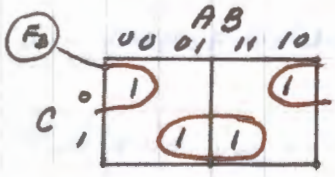


$F_2 = A + B$

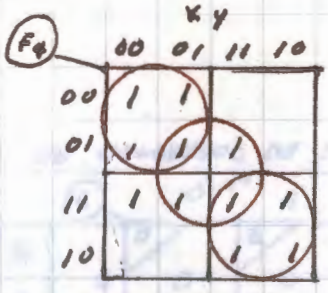
* GRUPOS TIPICOS DE CUATRO (4)



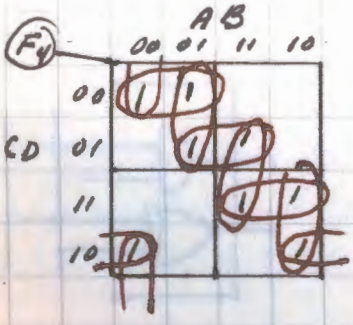
$F_3 = \bar{C} + \bar{B} = C \uparrow B$



$F_3 = \bar{B}\bar{C} + BC \Rightarrow B \odot C$

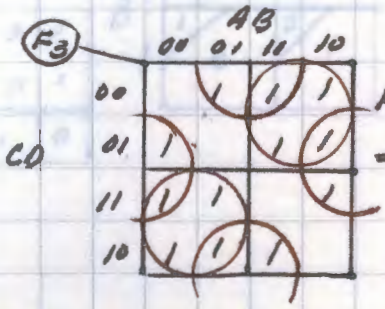


$F_4 = \bar{x}\bar{z} + yw + xz$



$F_4 = \bar{A}\bar{C}\bar{D} + B\bar{C}\bar{D} + AC\bar{D} + \bar{B}C\bar{D}$

$F_4 = \bar{A}\bar{B}\bar{D} + \bar{A}B\bar{C} + ABD + A\bar{B}C$



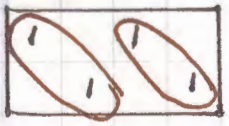
$F_3 = A\bar{C} + \bar{A}C + \bar{B}D + B\bar{D}$

$\rightarrow (A \oplus C) + (B \oplus D)$

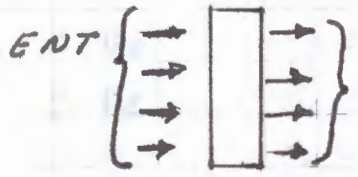
GRUPOS TIPICOS DE OCHO

$F = \bar{D} + \bar{B} = D \uparrow B.$

GRUPOS NO PERMITIDOS



SISTEMA COMBINACIONAL

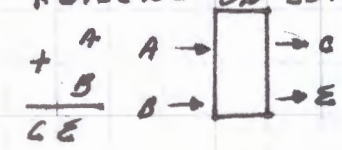


DEFINICION: EN UN SISTEMA COMBINACIONAL LAS SALIDAS SOLO DEPENDEN DE LAS COMBINACIONES DE ENTRADA

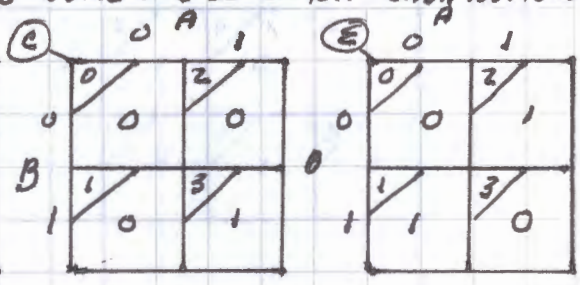
METODOLOGIA DEL DISEÑO COMBINACIONAL

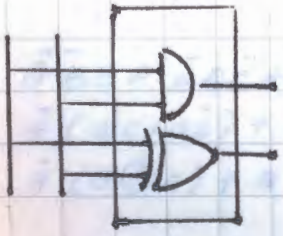
1.- ESPECIFICAR EL SISTEMA
2.- DEFINIR ENTRADAS Y SALIDAS
3.- TRASLADAR EL COMPORTAMIENTO DEL SISTEMA A UNA TABLA DE VERDAD
4.- MINIMIZAR LA FUNSION
   a).- MANIPULACION ALGEBRAICA
   b).- MAPA DE KARNAUGH
5.- IMPLEMENTAR

*DISEÑE UN SUMADOR BINARIO DE NUMEROS DE UN BIT CADA NUMERO

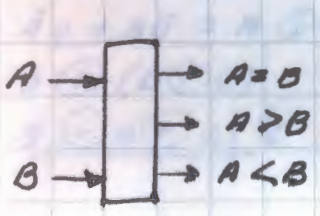


M	A	B	C	E
0	0	0	0	0
1	0	1	0	1
2	1	0	0	1
3	1	1	1	0





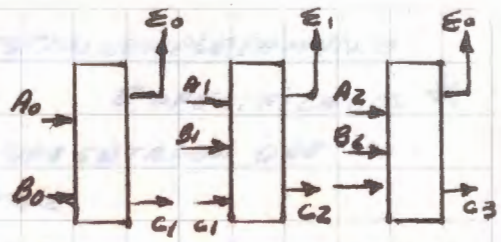
*DISEÑE UN COMPARADOR BINARIO DE LOS NUMEROS DE UN BIT CADA NUMERO A, B; = A=B; A>B; A<B



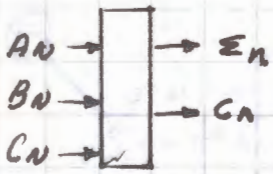
M	A	B	A=B	A>B	A<B
1	0	0	1	0	0
2	0	1	0	0	1
3	1	0	0	1	0
4	1	1	1	0	0

* DISEÑO POR MODULOS *

C	$C_2\ C_1$	$C_3\ C_2\ C_1$
$A_1\ A_0$	$A_2\ A_1\ A_0$	$A_3\ A_2\ A_1\ A_0$
$+\ B_1\ B_0$	$B_2\ B_1\ B_0$	$B_3\ B_2\ B_1\ B_0$
$C_2\ E_1\ E_0$	$C_3\ E_2\ E_1\ E_0$	$C_4\ E_3\ E_2\ E_1\ E_0$



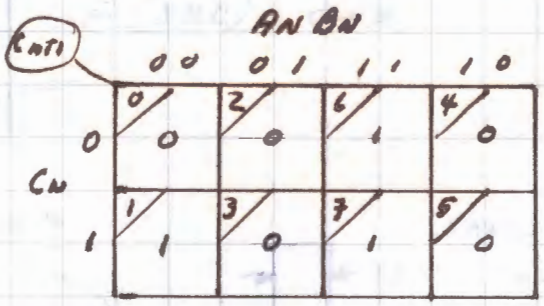
½ SUMADOR SUMADOR COMPLETO

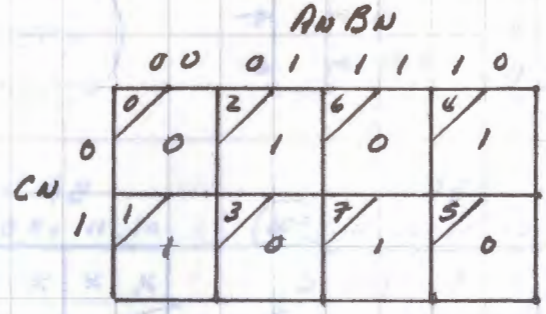


SUMADOR ENACIMO

$FCN_4\ (A_N B_N C_N) = A_N B_N + A_N C_{N+} B_N C_N$ *

M	A_N	B_N	C_N	C_{N+1}	E_N
0	0	0	0	0	0
1	0	0	1	0	1
2	0	1	0	0	1
3	0	1	1	1	0
4	1	0	0	0	1
5	1	0	1	1	0
6	1	1	0	1	0
7	1	1	1	1	1





$\bar{A}\bar{B}C + \bar{A}B\bar{C} + ABC + A\bar{B}\bar{C}$

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

$\bar{A}(B \oplus C) + A\overline{(B \oplus C)}$

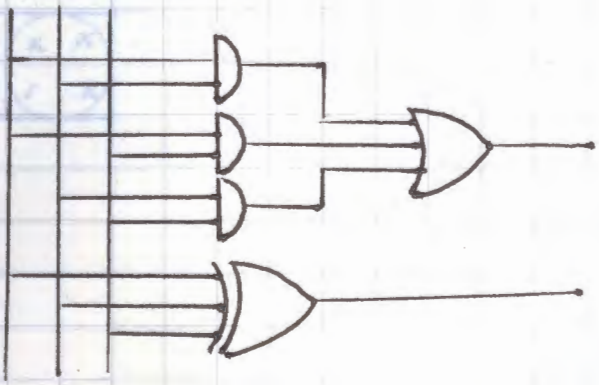
$B \oplus C = y$

$\overline{B \oplus C} = \bar{y}$

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

$A \oplus (B \oplus C)$

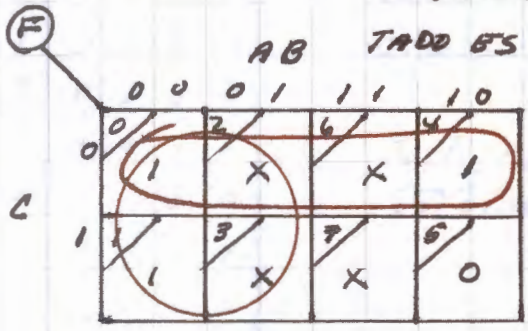
$A \oplus B \oplus C$ *



* SISTEMA COMBINACIONAL QUE NO ESTAN COMPLETAMENTE ESPECIFICADOS *

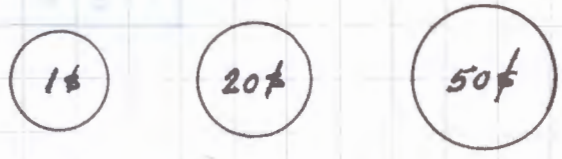
* CAN IT HAPEN (NO PUEDE SUCEDER) UNA ENTRADA QUE NO PUEDE PRESENTAR

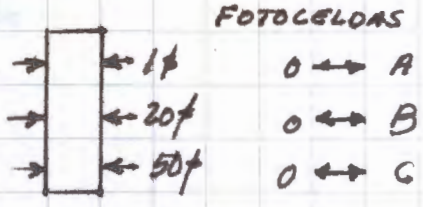
* DON'T CARE (NO IMPORTA) UNA SALIDA QUE IMPORTA EL VALOR QUE SE LE ASIGNA, EL RESULTADO ES EL MISMO.



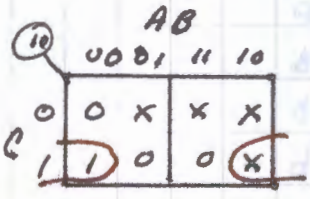
$F(ABC) = \bar{C} + \bar{A}$

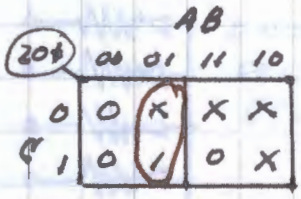
* DELACTOR DE MONEDAS *

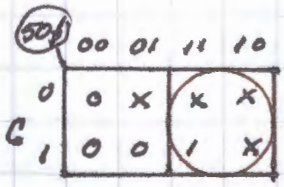


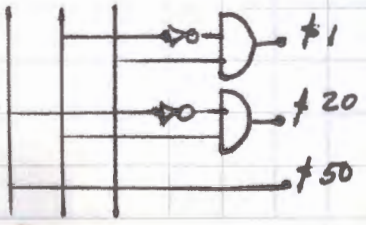


M	A	B	C	1¢	20¢	50¢
0	0	0	0	0	0	0
1	0	0	1	1	0	0
2	0	1	0	X°	X°	X°
3	0	1	1	0	1	0
4	1	0	0	X	X	X
5	1	0	1	X	X	X
6	1	1	0	X	X	X
7	1	1	1	0	0	1









* DECODIFICADOR DE BCD O SIETE SEGMENTOS

BCD = DECIMAL CODIFICADO EN BINARIO

DESIMAL / N	BCD B	C	D
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	0	1	0
5	0	1	0
6	0	1	1
7	0	1	1
8	1	0	0
9	1	0	0

$45_{(10)} = N_{(BCD)}$

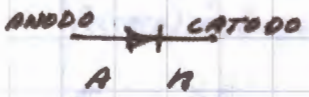
$01000101_{(BCD)}$

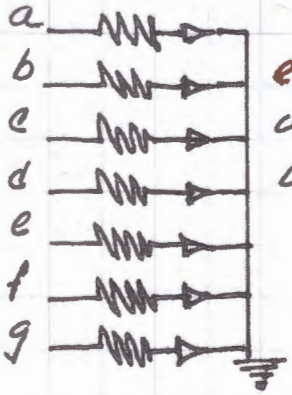
$973_{(10)} = N_{(BCD)}$

$1001\ 0111\ 0011_{(BCD)}$

DISPLAY

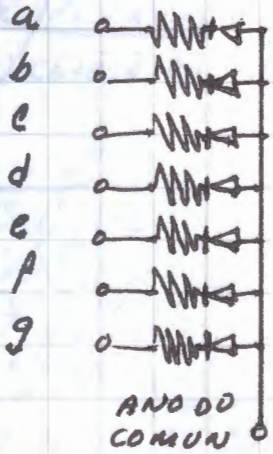
"LED" DIODO EMISOR DE LUZ





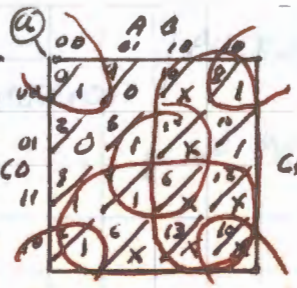
ENCIENDE CON UN (UNO) "1" LOGICO

CATODO COMUN

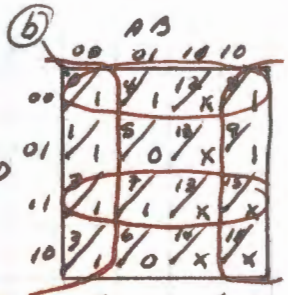


ENCIENDE CON UN "0" (CERO)

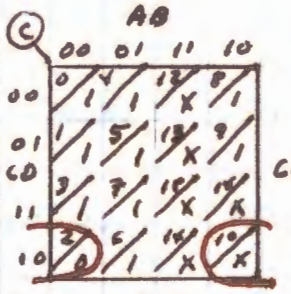
M	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	X	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	X	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	X	0	1	1
10	1	0	1	0		X	X	X	X	X	X
11	1	0	1	1		X	X	X	X	X	X
12	1	1	0	0		X	X	X	X	X	X
13	1	1	0	1		X	X	X	X	X	X
14	1	1	1	0		X	X	X	X	X	X
15	1	1	1	1		X	X	X	X	X	X



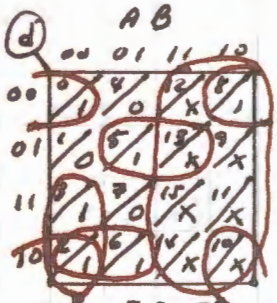
$Fa(ABCD) = A + C + B\bar{D} + \bar{B}D$



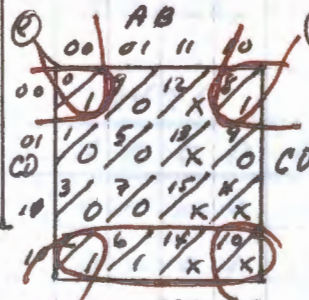
$Fb(ABCD) = \bar{B} + \bar{C}\bar{D} + CD$



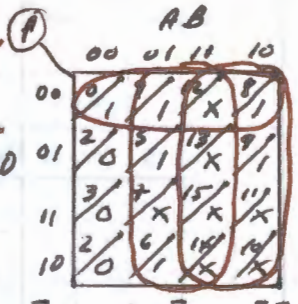
$Fc(ABCD) = \bar{B}\bar{C}\bar{D} = B + \bar{C} + D$



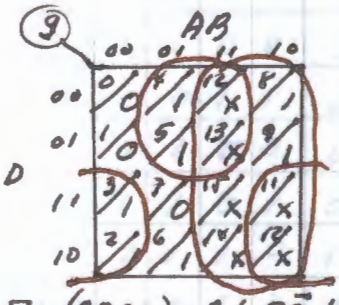
$Fd = A + \bar{A}\bar{C}\bar{D} + \bar{A}BC + \bar{B}\bar{D}$



$Fe(ABCD) = C\bar{D} + \bar{B}\bar{C}\bar{D} + B\bar{D}$



$Ff(ABCD) = \bar{A} + B + \bar{C}\bar{D}$



$Fg(ABCD) = A + B\bar{C} + C\bar{D} + C\bar{B}$

CODIGOS { NUMERICOS / ALFANUMERICOS }

NUMERICOS { PESADOS (a) / NO PESADOS (b) }

CODIGO: ES UN CONJUNTO DE NUMEROS O LETRAS PARA REPRESENTAR ALGO O CUALQUIER COSA.

a) PESADAS

1.- BINARIO NATURAL — $39_{(10)} = N_{(BCD)}$ — $39_{(10)} = 0011, 1001\ (BCD)$

2.- BCD * — $\overbrace{0011}, \overbrace{1001}$

3.- EXCESO-3 * — $0011, 1001\ (BCD)$ — $39_{(10)} = ?\ (EX-3)$

4.- 2421 *

$39_{(10)} = 0011, 1001\ (BCD)$

$= 0110\,0, 1100\ (EX-3)$

b) NO PESADAS 1.- GRAY

* CODIGO DECIMAL

	BINARIO				BCD				EX-3				2421				GRAY			
M	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1
2	0	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	1
3	0	0	1	1	0	0	1	1	0	1	1	0	0	0	1	1	0	0	1	0
4	0	1	0	0	0	1	0	0	0	1	1	1	0	1	0	0	0	1	1	0
5	0	1	0	1	0	1	0	1	1	0	0	0	1	0	1	1	0	1	1	1
6	0	1	1	0	0	1	1	0	1	0	0	1	1	1	0	0	0	1	0	1
7	0	1	1	1	0	1	1	1	1	0	1	0	1	1	0	1	0	1	0	0
8	1	0	0	0	1	0	0	0	1	0	1	1	1	1	1	0	1	1	0	0
9	1	0	0	1	1	0	0	1	1	1	0	0	1	1	1	1	1	1	0	1
10	1	0	1	0													1	1	1	1
11	1	0	1	1													1	1	1	0
12	1	1	0	0													1	0	1	0
13	1	1	0	1													1	0	1	1
14	1	1	1	0													1	0	0	1
15	1	1	1	1													1	0	0	0

CONBINACION DE BINARIO A GRAY

N(2) → N(GRAY)

1 0 1 1 1 0 1 (2)

1 1 1 0 0 1 1 (GRAY)

1 1 0 0 (2)

1 0 1 0 (GRAY)

CONVERCION DE GRAY A BINARIO

1 1 1 0 0 1 1 GRAY

1 0 1 1 1 0 1 (2)

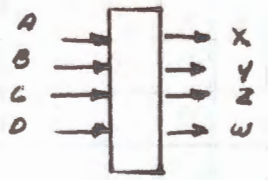
1 1 1 1 (GRAY)

1 0 1 0 (2)

CONVERTIDOR DE CODIGO

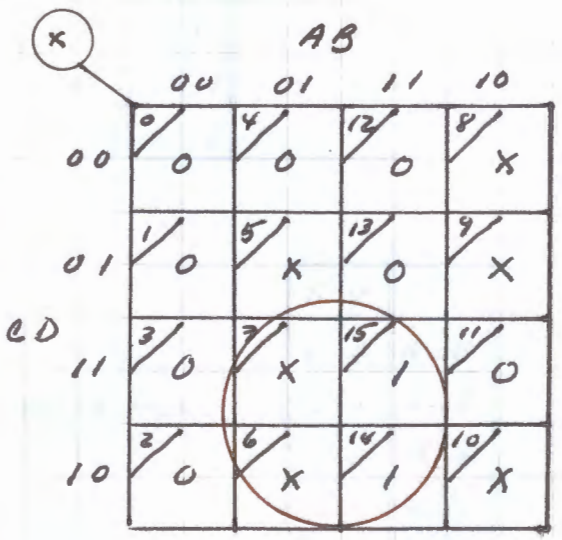
1).- BINARIO
2).- BCD
3).- EXCESO
4).- 2421
5).- GRAY

2421 → GRAY



2421 → 10 → GRAY

V/10	M	A	B	C	D	X	Y	Z	W
0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0	1
2	2	0	0	1	0	0	0	1	1
3	3	0	0	1	1	0	0	1	0
4	4	0	1	0	0	0	1	1	0
	5	0	1	0	1	X	X	X	X
	6	0	1	1	0	X	X	X	X
	7	0	1	1	1	X	X	X	X
	8	1	0	0	0	X	X	X	X
	9	1	0	0	1	X	X	X	X
	10	1	0	1	0	X	X	X	X
5	11	1	0	1	1	0	1	1	1
6	12	1	1	0	0	0	1	0	1
7	13	1	1	0	1	0	1	0	0
8	14	1	1	1	0	1	1	0	0
9	15	1	1	1	1	1	1	0	1



$X = \bar{B}C$ *

GRAY → 1421

V10	M	A	B	C	D	M	X	Y	Z	W
0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0	0	1
3	2	0	0	1	0	0	0	0	1	1
2	3	0	0	1	1	0	0	0	1	0
7	4	0	1	0	0	0	1	1	0	1
6	5	0	1	0	1	0	1	1	0	0
4	6	0	1	1	0	0	1	0	0	0
5	7	0	1	1	1	0	1	0	1	1
15	8	1	0	0	0	1	1	0	1	1
14	9	1	0	0	1	1	0	1	0	0
12	10	1	0	1	0	1	0	0	1	0
13	11	1	0	1	1	1	0	0	1	1
8	12	1	1	0	0	0	1	1	1	0
9	13	1	1	0	1	0	1	1	1	1
14	14	1	1	1	0	1	0	0	0	1
10	15	1	1	1	1	1	0	0	0	0

BCD → 2421

V10	M	A	B	C	D	X	Y	Z	W
	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	0	0	1
	2	0	0	1	0	0	0	1	0
	3	0	0	1	1	0	0	1	1
	4	0	1	0	0	0	1	0	0
	5	0	1	0	1	1	0	1	1
	6	0	1	1	0	1	1	0	0
	7	0	1	1	1	1	1	0	1
	8	1	0	0	0	1	1	1	0
	9	1	0	0	1	1	1	1	1
	10	1	0	1	0	X	X	X	X
	11	1	0	1	1	X	X	X	X
	12	1	1	0	0	X	X	X	X
	13	1	1	0	1	X	X	X	X
	14	1	1	1	0	X	X	X	X
	15	1	1	1	1	X	X	X	X

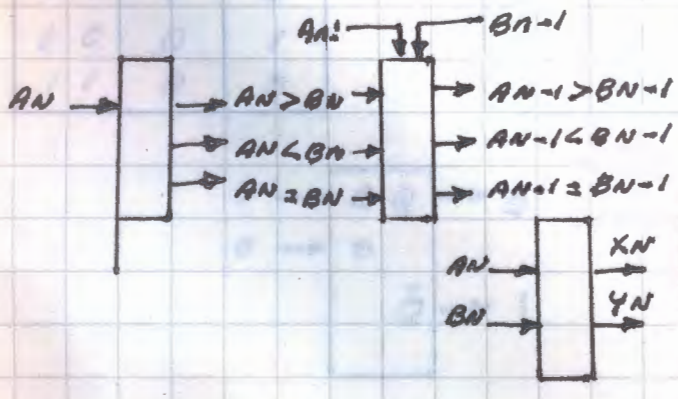
COMPARADOR COMPLETO

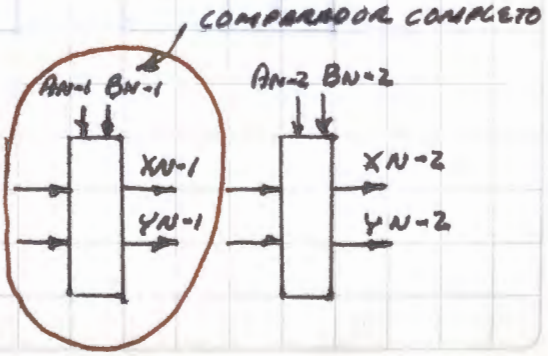
A 2, 3, 4, 6

B 2 3 4 5

→ DE MAYOR PESO A MENOR PESO

X	Y	
0	0	A=B
0	1	A<B
1	0	A>B
1	1	X X





					A>B	A<B	A=B
W	X	Y	A	B	x_1	y_1	
0	0	0	0	0	0	0	1
1			0	1	0	1	0
2			1	0	1	0	0
3			1	1	0	0	1
4	0	1	0	0	0	1	0
5			0	1	0	1	0
6			1	0	0	1	0
7			1	1	0	1	0
8	1	0	0	0	1	0	0
9			0	1	1	0	0
10			1	0	1	0	0
11			1	1	1	0	0
12	1	1	0	0	X	X	X
13			0	1	X	X	X
14			1	0	X	X	X
15			1	1	X	X	X

"FLIP FLOPS"

- MEMORIA CON CAPACIDAD DE UN SOLO BIT

FF's
- R-S → RESET-SET
- J-K →
- D →
- T → TRIGER
- S-C → SET-CLEAR

FLIP-FLOPS "R-S"

RESET-SET

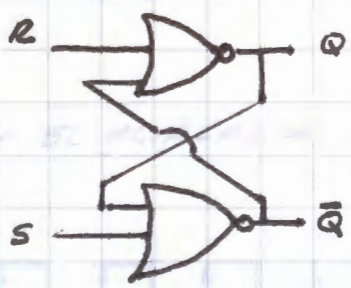
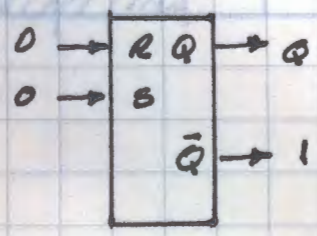


TABLA CARACTERISTICA

R	S	Q_{n+1}	$\bar{Q}_{n+1}$
0	0	0	1
0	0	1	0
0	1	1	0
1	0	0	1
1	1	0	0

A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

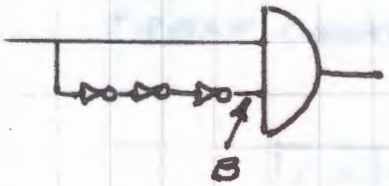
R	S	Q_{n+1}
0	0	Q_n
0	1	1
1	0	0
1	1	?



(F-F) R S CON RELOJ

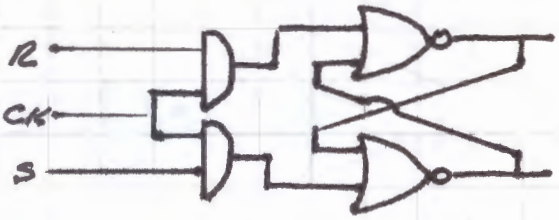
CK = RELOJ

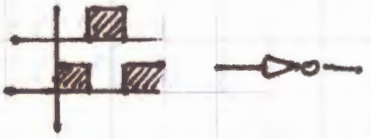
CP = RELOJ DE PULSO

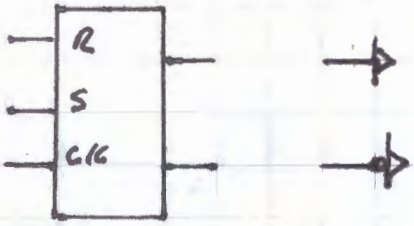


SEÑAL DE SINCRONIA

TP = TIEMPOS DE PROPAGACION







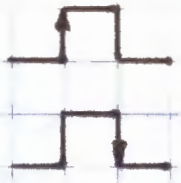
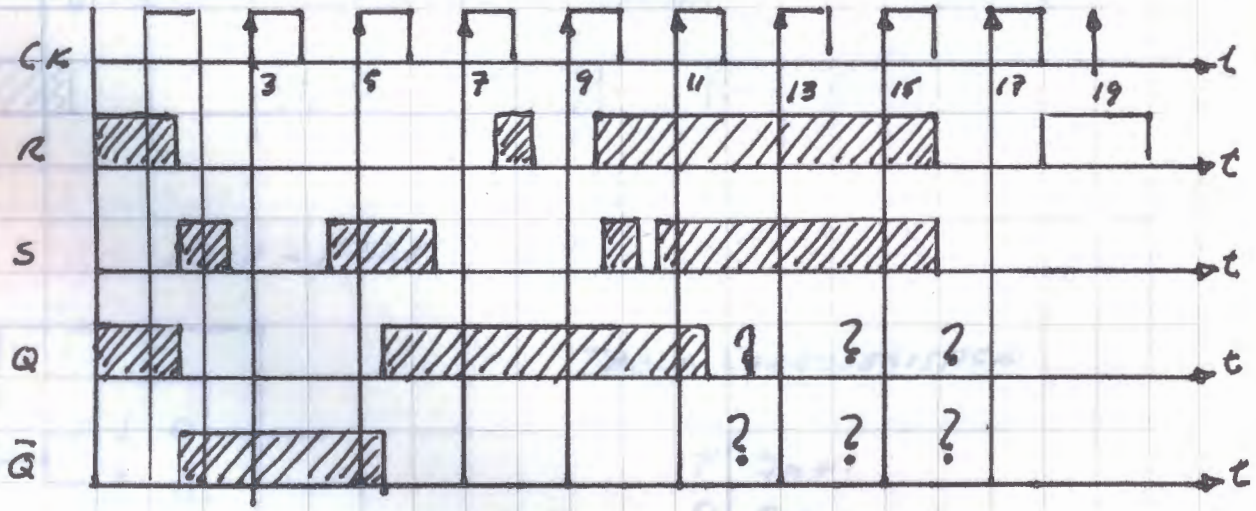


DIAGRAMA DE TIEMPOS PARA EL FLIP-FLOP R S



FLIP - FLOP

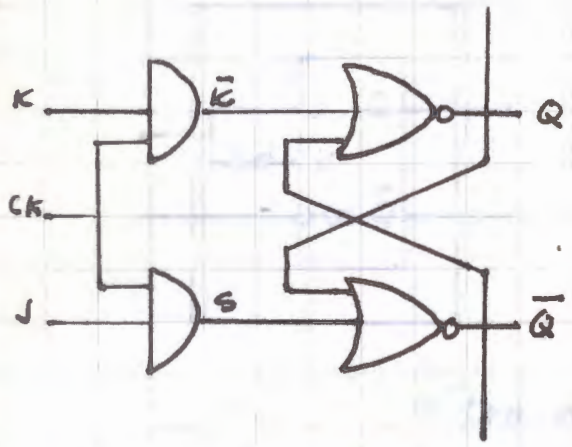
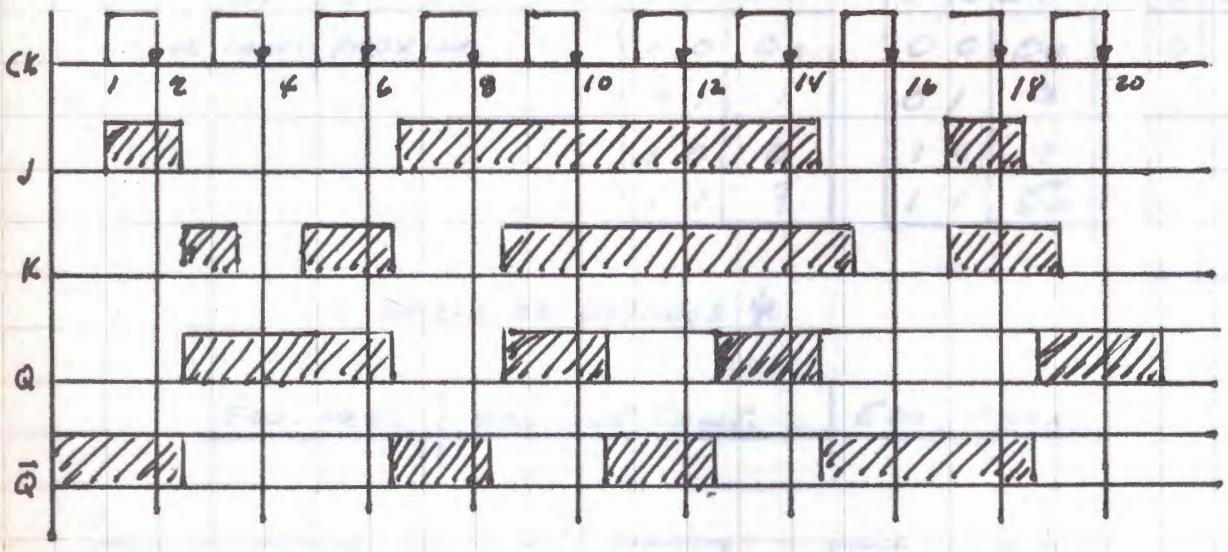


TABLA CARACTERISTICA

J	K	Q_{n+1}
0	0	Q_n
0	1	0
1	0	1
1	1	$\bar{Q}_n$



FLIP - FLOP "T"

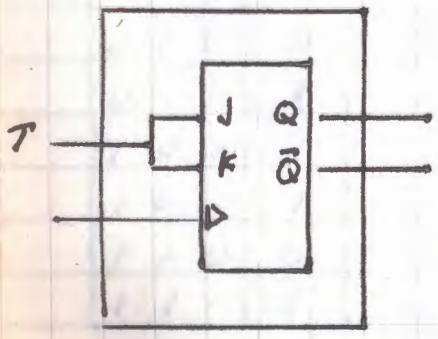
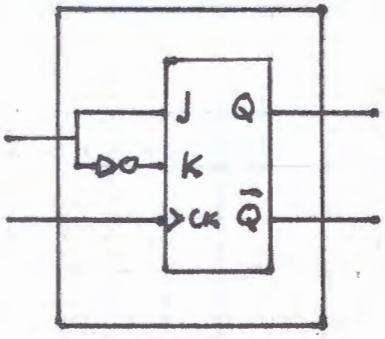


TABLA CARACTERISTICA

T	Q_{n+1}
0	Q_n
1	$\bar{Q}_n$

FLIP-FLOP "D"



"TABLA CARACTERISTICA"

D	Qn+1
0	0
1	1

"TABLAS DE LOS FLIPS FLOPS"

TABLA CARACTERISTICA

ENT. DE CANT.	ENDO PROXIM

R	S	Qn+1
0	0	Qn
0	1	1
1	0	0
1	1	?

J	K	Qn+1
0	0	Qn
0	1	0
1	0	1
1	1	$\overline{Qn}$

D	Qn+1
0	0
1	1

T	Qn+1
0	Qn
1	$\overline{Qn}$

* TABLA DE ESTADOS *

EDO. PRES	ENT. DE CONT.	EDO. PROX.

Qn	R	S	Qn+1
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	?
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	?

Qn	J	K	Qn+1
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Qn	T	Qn+1
0	0	0
0	1	1
1	0	1
1	1	0

Qn	D	Qn+1
0	0	0
0	1	1
1	0	0
1	1	1

* TABLA DE EXICACION *

EDO. PRES.	EDO. PROX	ENT. DE CONT.

Q_n	Q_{n+1}	R	S	J	K	T	D
0	0	X	0	0	X	0	0
0	1	0	1	1	X	1	1
1	0	1	0	X	1	1	0
1	1	0	X	X	0	0	1

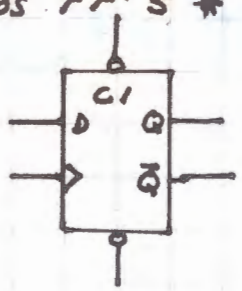
* OTRAS ENTRADAS DE CONTROL A LOS FF'S *

CLEAR – CL — cl — cl

PRESET – Pr — pr — pr

Q=0

Q=1



Cl	P_r	Ck	D	Q	$\bar{Q}$
L	H	X	X	L	H
H	L	X	X	H	L
L	L	X	X	H*	H*
H	H	↑	H	H	L
H	H	↓	L	L	H
H	H	L	X	Q	$\bar{Q}$

H = HAIG = 1

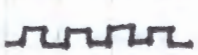
L = LOW = 0

X = NO IMPORTA

* MULTIBIBRADORES *

a) BIESTABLE

c) ESTABLE



b) MONOESTABLE

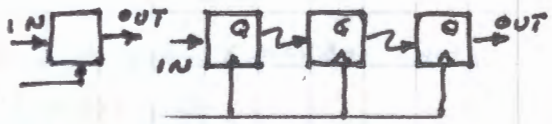
1.- REDISPARABLE

1.- NO REDISPARABLE

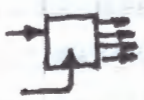
REGISTROS DE CORRIMIENTOS

a) SISO

SERIAL IN SERIAL OUT



b) SIPO



c) SIPO

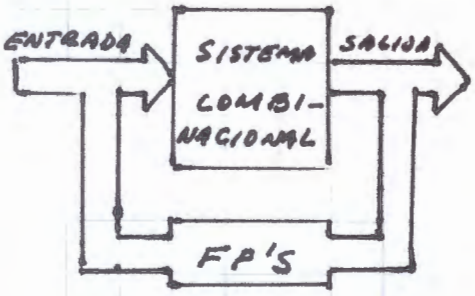
d) PIPO

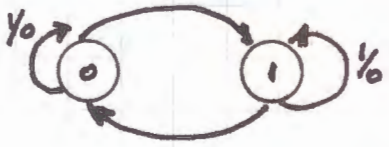
REGISTRO DE CORRIENTE UNIVERSAL: PUEDE CONCENTRARSE EN:
SISO; SIPO; PISO; PIPO.

* DISEÑO SECUENCIAL *

* SISTEMA SECUNCIAL: → ES AQUEL QUE LOS VALORES DE SALIDA NO SOLO DEPENDEN DE LAS COMBINACIONES DE ENTRADA SINO QUE TAMBIEN DE LAS SALIDAS MISMAS

1).- PASIVOS 2).- ACTIVOS *).DIAGRAMA DE TRANSICION *





ENTRADA
N/0 SALIDO.

* TABLA DE ESTADO *

ESTADOS PRESENTE		ESTADOS PROXIMOS	ESTADOS DE CAMBIO		SALIDA
N	QA	QA+1	JA	KA	D
0	0	1	1	X	0
0	1	0	X	1	1
1	0	0	0	X	0
1	1	1	X	0	0

* PARA LLENAR LOS ESTADOS PROXIMOS A LAS SALIDAS NOS BASAMOS EN EL DIAGRAMA DE TRANSICION.
* PARA OBTENER LOS VALORES DE LAS ENTRADAS DE CONTROL. COMPARAMOS LOS VALORES DE LOS ESTADOS PRESENTES Y ESTADOS PROXIMOS CON LA TABLA DE EXITACION DEL FF'S CORRESPONDIENTE y OBTENEMOS LAS ENTRADAS DE CONTROL

N	Q_A	J_A	K_A	D

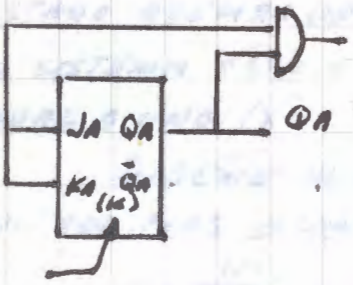
Q_A \ N	0	1
0	1	0
1	X	X

$F_{JA} = \bar{N}$

Q_A \ N	0	1
0	X	X
1	1	0

$K_A = \bar{N}$

$J_A = K_A = \bar{N}$



R_A	S_A
0	1
1	0
X	0
0	X

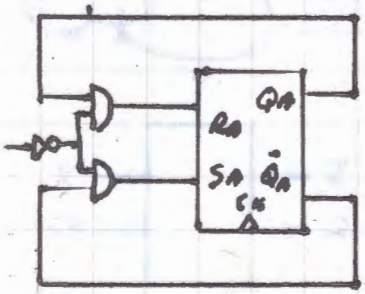
Q_A \ N	0	1
0	0	X
1	1	0

$R_A = \bar{N} Q_A$

Q_A \ N	0	1
0	1	0
1	0	X

$S_A = \bar{N} \bar{Q}_A$

* ⟶ D



* METODOLOGIA DE DISEÑO SECUENCIAL *

1.- ESPECIFICAR EL SISTEMA MEDIANTE UN DIAGRAMA DE TRANSICION

2.- ENUMERAR LAS ENTRADAS Y SALIDAS

3.- DETERMINAR EL NUMERO DE FF'S ASI COMO SELECCIONAR EL TIPO O TIPOS DE FF'S

4.- TRASLADAR EL COMPORTAMIENTO DEL SISTEMA A UNA TABLA DE ESTADOS

5.- OBTENER LAS FUNCIONES DEL SISTEMA COMBINACIONAL USANDO MAPAS DE KARNAUGH

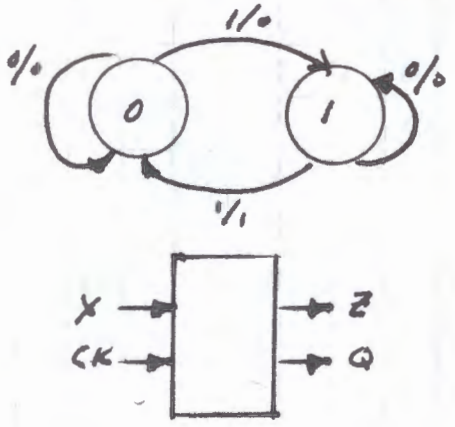
6.- IMPLEMENTAR

EJEMPLO Nº 1

DISEÑE UN SISTEMA SECUENCIAL DE DOS ESTADOS QUE CONTENGAN UNA ENTRADA (X) DE MODO QUE:

SI (X=1) EL SISTEMA DEBERA DE CAMBIAR DE - ESTADO SI (X=0) EL SISTEMA DEBERA PERMANECER EN EL MISMO ESTADO, ADEMAS UNA SALIDA Z QUE SERA IGUAL A (Z=1) SI EL SISTEMA ESTA EN ESTADO (1) (Q=1) Y LA ENTRADA IGUAL A UNO (X=1)

DISEÑE CON TODOS LOS FF'S, Y ESCOJA EL RE - SULTADO MAS ECONOMICO.

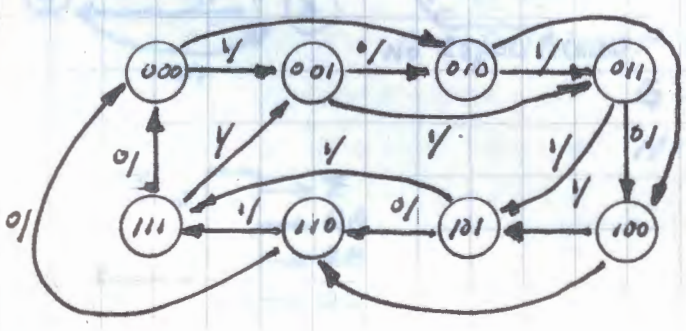


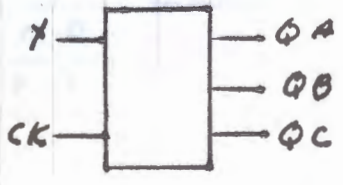
ESTADOS PRESENTES	ESTADOS PROXIMOS	ENTRADAS DE CONTROL				SALIDA
Q A	Q+1	R S		J K	T D	Z
0 0	0	X 0		0 X	0 0	0
0 1	1	0 X		X 0	0 1	0
1 0	1	0 1		1 X	1 1	0
1 1	0	1 0		X 1	1 0	1

DISEÑE UN SISTEMA SECUENCIA DE (8) ESTADOS CON UNA ENTRADA (X) DE MODO QUE: SI (X=0) LA SECUENCIA DEBERA SER POR LOS ESTADOS PARES. SI (X=1) LA SE- CUENCIA DEBERA SER POR LOS ESTADOS IMPAR.

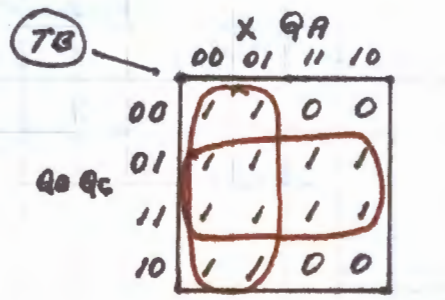
ADEMAS SI EL SISTEMA ESTA EN ESTADO IMPAR Y (X=1) EL ESFUERZO PROXIMO SERA EL IMPAR CONSECUTIVO Y NO ESFUERZO. X=0

* EL ESTADO CERO (0) ES PAR CONSIDERADO COMO PAR.





ESTADOS PRESENTES				ESTADOS PROXIMOS			ENTRADAS DE CONTROL		
X	QA	QB	QC	QA+1	QB+1	QC+1	TA	TB	TC
0	0	0	0	0	1	0	0	1	0
0	0	0	1	0	1	0	0	1	1
0	0	1	0	1	0	0	1	1	0
0	0	1	1	1	0	0	1	1	1
0	1	0	0	1	1	0	0	1	0
0	1	0	1	1	1	0	0	1	1
0	1	1	0	0	0	0	1	1	0
0	1	1	1	0	0	0	1	1	1
1	0	0	0	0	0	1	0	0	1
1	0	0	1	0	1	1	0	1	0
1	0	1	0	0	1	1	0	0	1
1	0	1	1	1	0	1	1	1	0
1	1	0	0	1	0	1	0	0	1
1	1	0	1	1	1	1	0	1	0
1	1	1	0	1	1	1	0	0	1
1	1	1	1	0	0	1	1	1	0



$TB = \overline{X} + QC$ *

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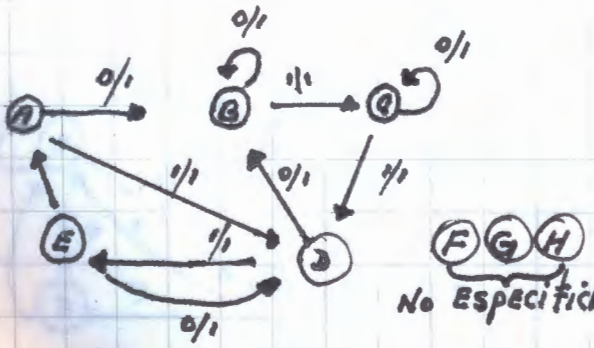
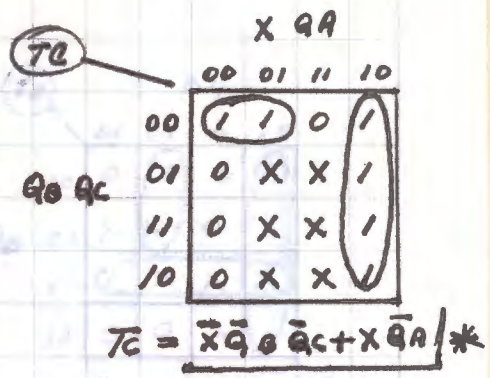
* SISTEMAS SECUENCIALES QUE NO ESTAN COMPLETAMENTE ESPECIFICADOS.



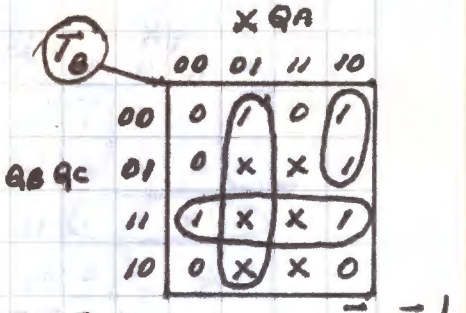
A =	0	0	0
B =	0	0	1
C =	0	1	0
D =	0	1	1
E =	1	0	0
F =	1	0	1
G =	1	1	0
H =	1	1	1

X = 0	X = 1
A → B	A → D
B → B	B → C
C → C	C → D
D → B	D → E
E → D	E → A.

	Estados Presentes				Estados Proximos			Entradas de Control			Salida
Es	X	Q_A	Q_B	Q_C	Q_{A+1}	Q_{B+1}	Q_{C+1}	T_A	T_B	T_C	Z
A	0	0	0	0	0	0	1	0	0	1	1
B	0	0	0	1	0	0	1	0	0	0	1
C	0	0	1	0	0	1	0	0	0	0	1
D	0	0	1	1	0	0	1	0	1	0	1
E	0	1	0	0	0	1	1	1	1	1	1
F	0	1	0	1	X	X	X	X	X	X	X
G	0	1	1	0	X	X	X	X	X	X	X
H	0	1	1	1	X	X	X	X	X	X	X
A	1	0	0	0	0	1	1	0	1	1	1
B	1	0	0	1	0	1	0	0	1	1	1
C	1	0	1	0	0	1	1	0	0	1	1
D	1	0	1	1	1	0	0	1	1	1	1
E	1	1	0	0	0	0	0	1	0	0	0
F	1	1	0	1	X	X	X	X	X	X	X
G	1	1	1	0	X	X	X	X	X	X	X
H	1	1	1	1	X	X	X	X	X	X	X



$T_C = \bar{X}\bar{Q}_B\bar{Q}_C + X\bar{Q}_A$ *



$T_B = \bar{X}\,Q_A + Q_B Q_C + X\bar{Q}_A\bar{Q}_B$ *

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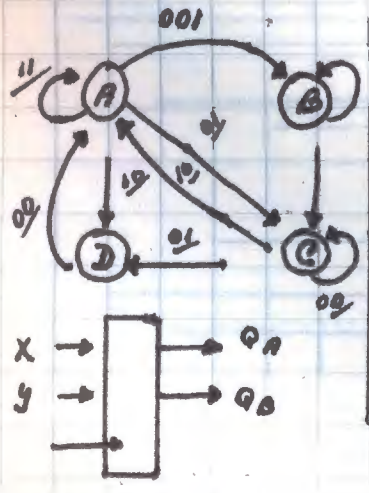
* Sistemas Secuenciales de Entradas Multiples *

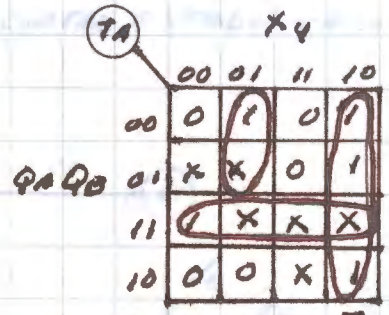


x y	x y	x y	x y
0 0	0 1	1 0	1 1
A→B	A→C	A→D	A→A
B→X	B→X	B→C	B→B
C→C	C→D	C→A	C→X
D→A	D→A	D→X	D→X

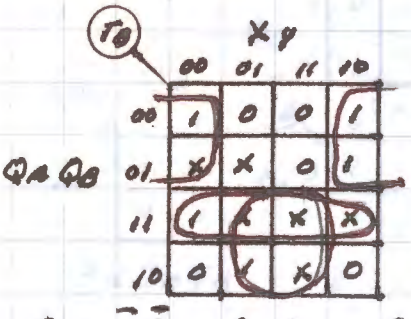
Dandole Valores a los Variables

A →	0	0
B →	0	1
C →	1	0
D →	1	1

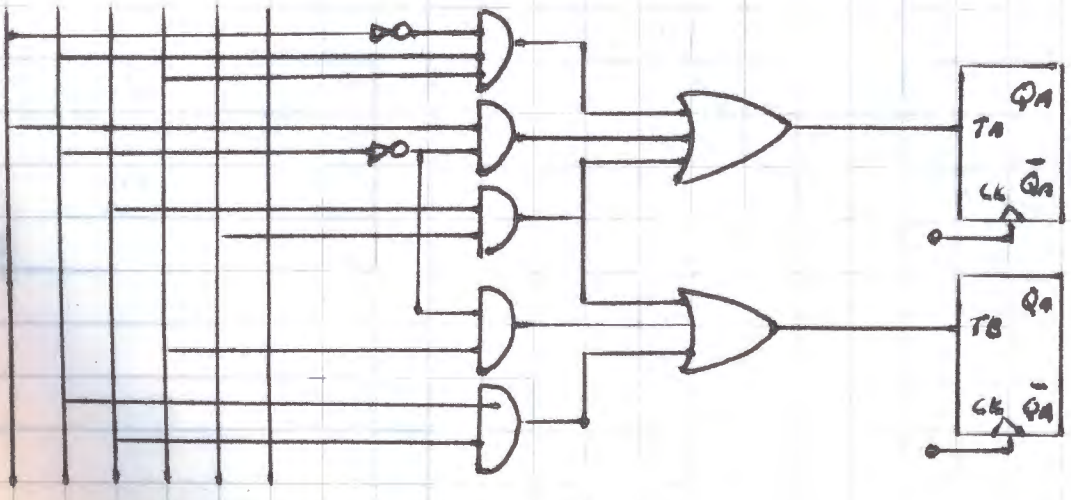
	ESTADOS PRESENTES				ESTADOS PROXIMOS		ENTRADAS DE CONTROL	
Es	X	Y	Q_A	Q_B	Q_{A+1}	Q_{B+1}	TA	TB
A	0	0	0	0	0	1	0	1
B			0	1	X	X	X	X
C			1	0	1	0	0	0
D			1	1	0	0	1	1
A	0	1	0	0	1	0	1	0
B			0	1	X	X	X	X
C			1	0	1	1	0	1
D			1	1	X	X	X	X
A	1	0	0	0	1	1	1	1
B			0	1	1	0	1	1
C			1	0	0	0	1	0
D			1	1	X	X	X	X
A	1	1	0	0	0	0	0	0
B			0	1	0	1	0	0
C			1	0	X	X	X	X
D			1	1	X	X	X	X



$TA = Q_A Q_B + X\bar{Y} + \bar{X}Y\bar{Q}_A$



$TB = \bar{Y}\bar{Q}_B + Q_A Q_B + YQ_B$



ELLI

* CONTADORES *

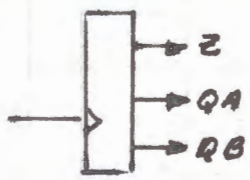
TIPOS DE CONTADORES

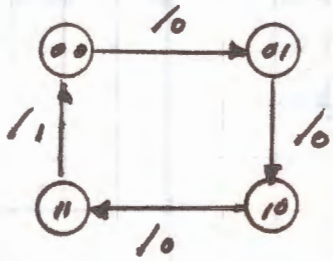
1).- BINARIO

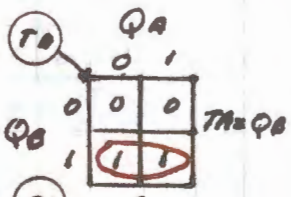
2).- DECADAS, BCD, DECIMALES

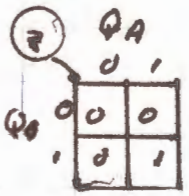
3).- CONTADORES ESPECIALES

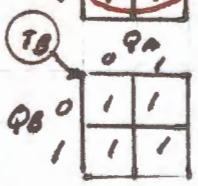
DISEÑO DE UN CONTADOR EN BINARIO NATURAL DE CUATRO ESTADOS ASCENDENTE (MODULO IV)



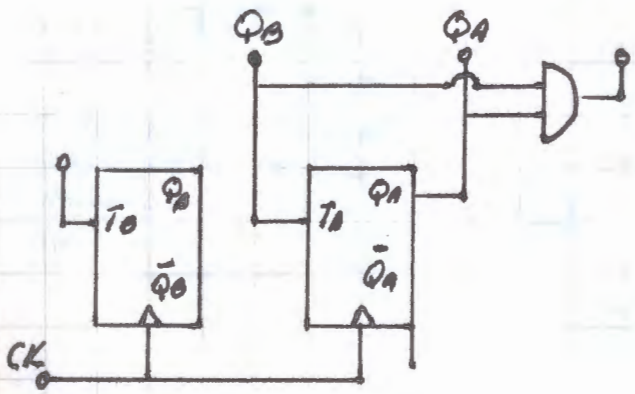


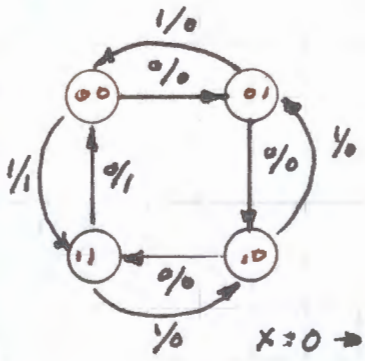






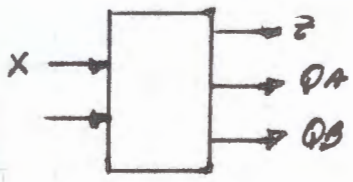
ESTADOS PRESENTES		ESTADOS PROXIMOS		ENTRADAS DE CONTROL		SALIDA
Q_A	Q_B	$Q_{A(t+1)}$	$Q_{B(t+1)}$	T_A	T_B	Z
0	0	0	1	0	1	0
0	1	1	0	1	1	0
1	0	1	1	0	1	0
1	1	0	0	1	1	1



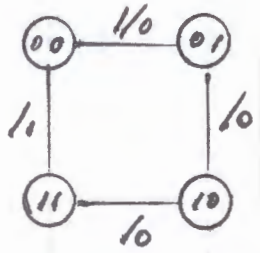


X=0 → ASCON

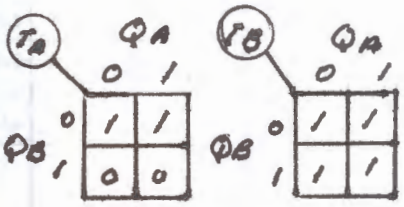
X=1 → DESCON



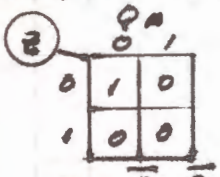
* DESCENDENTE *



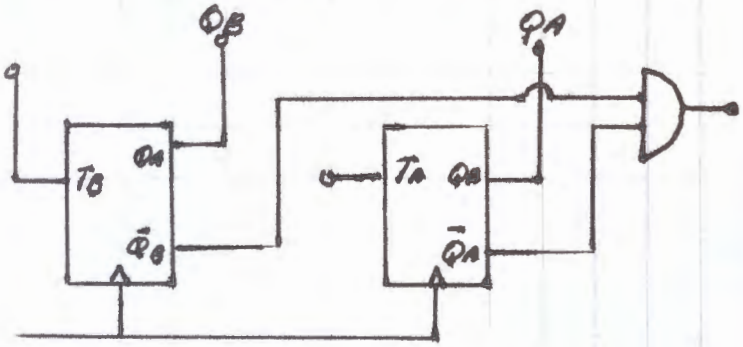
Q_A Q_D	Q_{AH} Q_{BH}	T_A T_B	z
0 0	1 1	1 1	1
0 1	0 0	0 1	0
1 0	0 1	1 1	0
1 1	1 0	0 1	0



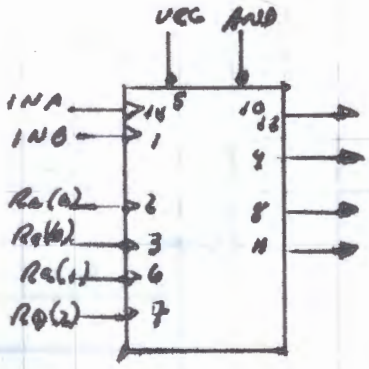
$T_A = \bar{Q}_B$ $\quad T_B = 1$

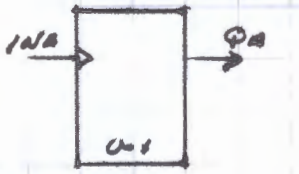


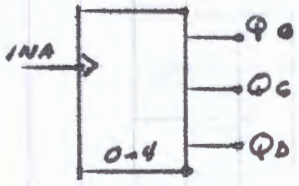
$z = \bar{Q}_A \bar{Q}_B$

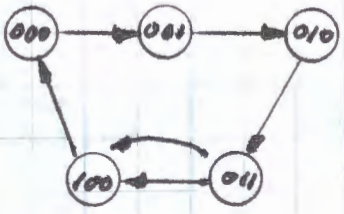


SN 74490

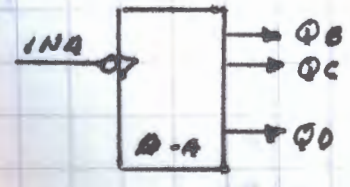




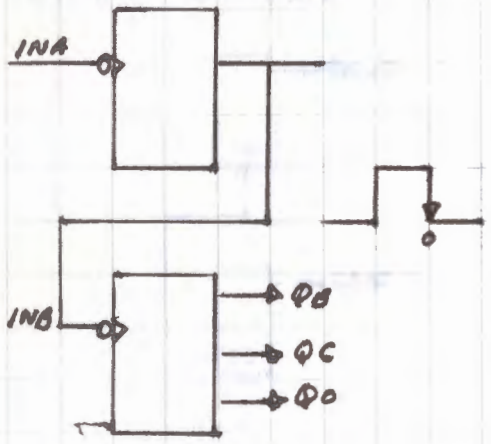




EN SN 7490 COMO CONTADOR DE DÉCADAS

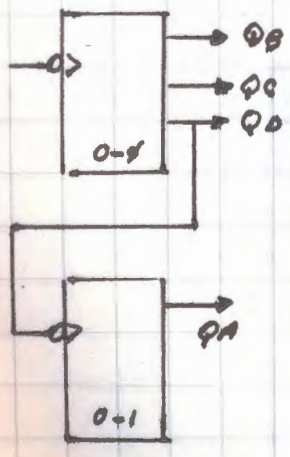


EN SN 7490 COMO CONTADOR DE DECADAS

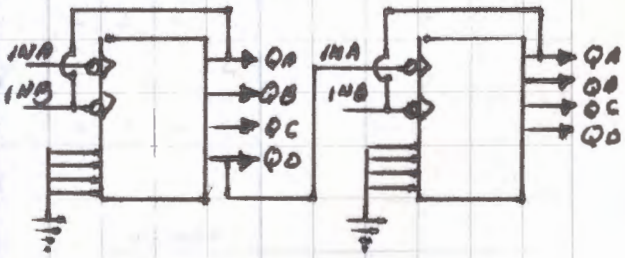


	0 4			0-1
No	QD	QC	QB	QA
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1

SN 7490 CONTADO EN

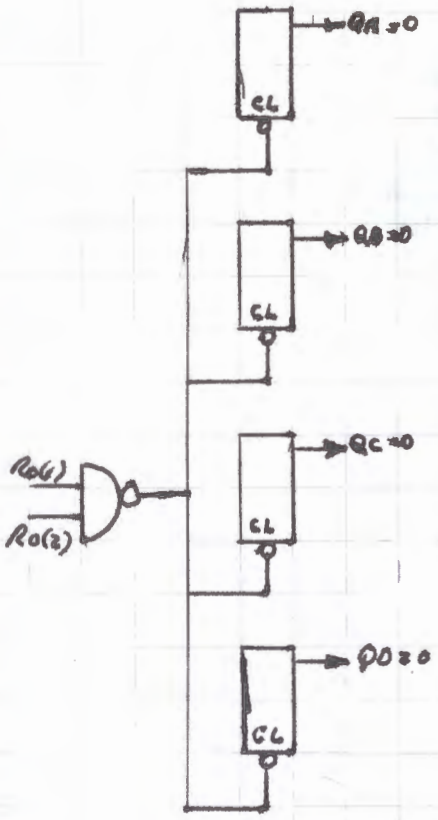


	8-4			0-1
No	QD	QC	QB	QA
0	0	0	0	0
2	0	0	1	0
4	0	1	0	0
6	0	1	1	0
3	1	0	0	0
1	0	0	0	1
3	0	0	1	1
5	0	1	0	1
7	0	1	1	1
9	1	0	0	1
0	0	0	0	0

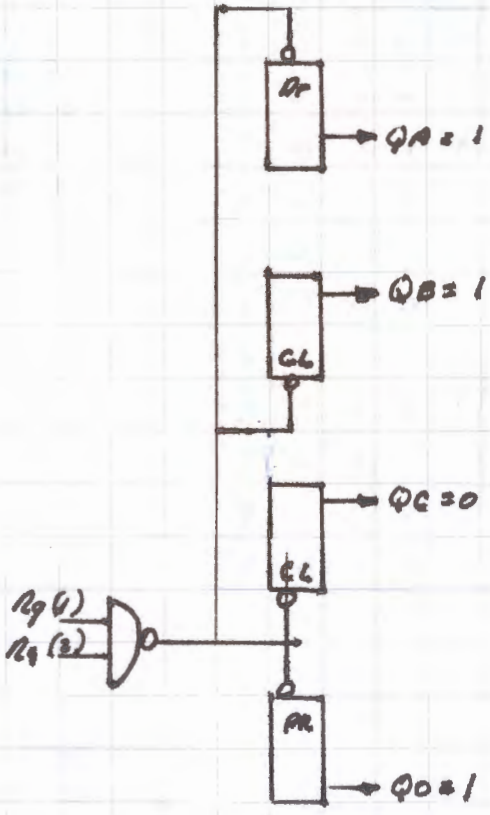


RESERTS

RESERT A CERO



RESERT A NUEVE

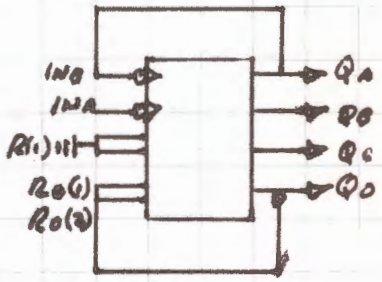


$R_0(1)$	$R_0(2)$	$R_9(1)$	$R_9(2)$	Q_D Q_C Q_B Q_A
X	L	H	H	L L L L
L	X	H	H	L L L L
H	H	X	X	H L L H
L	X	L	X	
L	X	X	L	CONTADOS
X	L	X	L	
X	L	L	X	

* CONTADORES PROGRAMABLES *

0 → X

a) 0 → 3



M	QD	Qc	QB	QA
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	0	0	0	0

b) 0 → 47