Ley De Acción De Masas.

Sea $R(T)$ la recombinación de pares electrón-hueco y $G(T)$ la generación de los mismos.

$$R(T) \propto n \cdot p \underset{\text{a una temperatura } T.}{\Longrightarrow} R(T) = r(T) \cdot n \cdot p = G(T) = ctte(T) \Rightarrow n \cdot p = ctte = n_i^2(T)^{*}$$

$^{*}\; n = p = n_i(T)$

Donde $n_i(T)$ es el número de portadores intrínsecos.

Nivel De Fermi Intrínseco.

Sea $n(T) = p(T) = n_i(T)$.

$$N_c\, e^{\frac{-(E_c - E_i)}{KT}} = N_v e^{\frac{+(E_i - E_v)}{KT}}$$

$$\frac{N_c}{N_v} = e^{\frac{+(E_c - E_i)}{KT}} \cdot e^{\frac{-(E_i - E_v)}{KT}} \; ; \; \frac{N_c}{N_v} = e^{\frac{-2E_i + E_v + E_c}{KT}}$$

Tomamos logaritmos: $\log\left|\frac{N_c}{N_v}\right| = \frac{-2E_i + E_v + E_c}{KT}$.

$$KT \log\left|\frac{N_c}{N_v}\right| = -2E_i + E_v + E_c \Longrightarrow E_i = \frac{E_c + E_v}{2} - \frac{KT}{2}\log\left|\frac{N_c}{N_v}\right|$$

$$\text{Si } N_c \simeq N_v \simeq 10^{19}\,\text{cm}^3 \Longrightarrow E_i \simeq \frac{E_v + E_c}{2} = \frac{E_g}{2}.$$

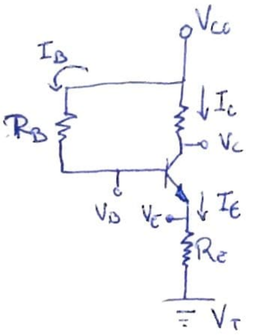
Transistores.

$$\begin{cases} I_E = I_B + I_C \\ V_{cc} - V_T = V_{CE} + I_C R_C + I_E R_E \\ V_{cc} - V_T = V_{BE}^{act} + I_B R_B + I_E R_E \\ I_C = \beta I_B \end{cases}$$

$$I_C^{sat} = \frac{V_{cc} - V_{CE}^{sat}}{R_C} \quad \text{con } V_{CE}^{act} \simeq 0{,}2\,V.$$

Si $\beta I_B \geq I_C^{sat} \Rightarrow$ región de saturación

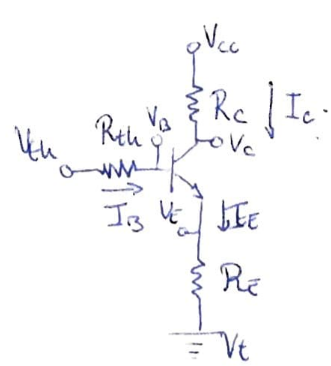
* Recordar la aprox. $\beta \simeq \beta + 1$.



Div. De Tensión.

$$V_{th} = \frac{R_2}{R_1 + R_2} V_{cc} \qquad R_{th} = \frac{R_1 R_2}{R_1 + R_2}$$

$$\begin{cases} V_{th} - V_T = I_B R_{th} + V_{BE}^{act} + I_E R_E \\ V_{cc} - V_T = I_C R_C + V_{CE} + I_E R_E \\ I_E = I_B + I_C \\ I_C = \beta I_B. \end{cases}$$



Teorema de Exp. de Shannon.

"Cualquier función booleana de n variables $\{x_1, \dots, x_n\}$: $F(x_1, x_2, \dots, x_n)$ con $x_i \in \{0,1\}$ se puede expresar de la siguiente forma:

$$F(x_1, \dots, x_n) = x_1 F(1, x_2, \dots, x_n) + \bar{x}_1 F(0, x_2, \dots, x_n)"$$

* Esto garantiza la tabla de verdad obtenida por un polinomio. (Su paso).

Dem

$x_1 = 0$

$$F(0, x_2, \dots, x_n) = 0F(1, x_2, \dots, x_n) + \bar{0}F(0, x_2, \dots, x_n) = 0 + 1F(0, x_2, \dots, x_n) = F(0, x_2, \dots, x_n).$$

$x_1 = 1$

$$F(1, x_2, \dots, x_n) = 1F(1, x_2, \dots, x_n) + \bar{1}F(0, x_2, \dots, x_n) = 1F(1, x_2, \dots, x_n) + 0 = F(1, x_2, \dots, x_n).$$

Minterms - Maxterms.

Sea $F = x + yz$ $\quad F(x,y,z) = x\cdot(y+\bar{y})(z+\bar{z}) + (x+\bar{x})yz =$

$\qquad\qquad m_3 \quad m_6 \quad m_5 \quad m_4 \quad m_7$

$= xyz + x\bar{y}z + x\bar{y}\bar{z} + xy\bar{z} + xyz + \bar{x}yz = xyz + x\bar{y}z + x\bar{y}\bar{z} + xy\bar{z} + \bar{x}yz =$

$= \sum_3(3,4,5,6,7)$

$\overline{F}(x,y,z) = \sum_3(0,1,2)$

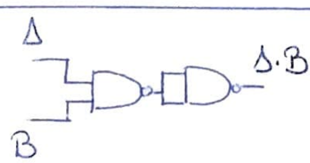
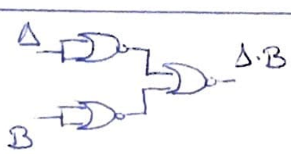
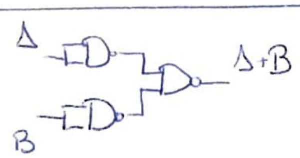
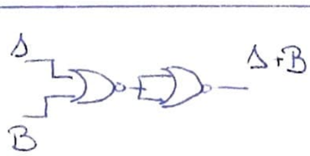
$\overline{\overline{F}} = \overline{\sum_3(0,1,2)} = \overline{m_0 + m_1 + m_2} = \overline{m_0}\cdot\overline{m_1}\cdot\overline{m_2} = (\overline{\bar{x}\bar{y}\bar{z}})\cdot(\overline{\bar{x}\bar{y}z})\cdot(\overline{\bar{x}y\bar{z}}) =$

$= (x+y+z)(x+y+\bar{z})(x+\bar{y}+z) = M_7 \cdot M_6 \cdot M_5 = \prod_3(5,6,7)$ *

* Truco $m_0 + M_7 \to 7$ $\quad m_2 + M_5 \to 7$

$m_1 + M_6 \to 7$

Universalidad Nand - Nor.

NAND	NOR	
		NOT
		AND
		OR.

Biestables y Tablas de Entradas.

Tabla de estados de un J-K

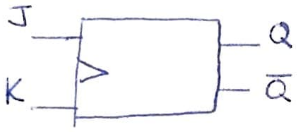
J	K	Q(t+1)
0	0	Q(t)
0	1	0
1	0	1
1	1	$\overline{Q(t)}$

Tabla de estados de un T.

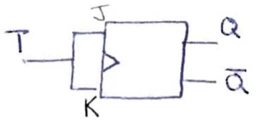
T	Q(t+1)
0	Q(t)
1	$\overline{Q(t)}$

Tabla de estados de un D.

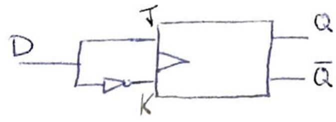
D	Q(t+1)
0	0
1	1



Biestable J-K



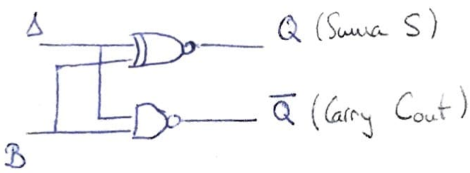
Biestable T.



Biestable D.

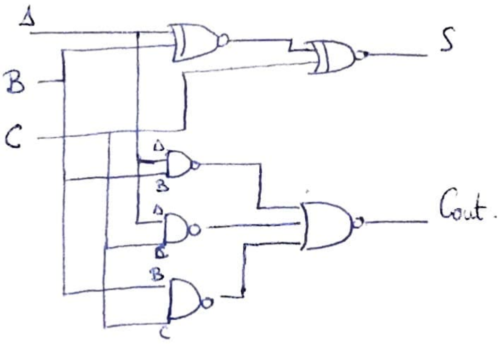
Semisumador y Sumador.

Semisumador

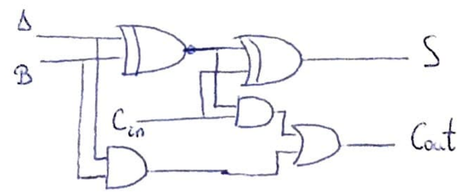


A	B	Cout	~~...~~ S.
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Sumador *



*



$\Rightarrow C = C_{in}$.

C A B suma carry

0 + 1 + 0 = 1 → 0.

0 + 1 + 1 = 0 → 1

1 + 1 + 1 = 1 → 1.

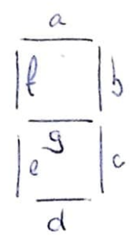
0 → $\bar{a}$
1 → a } m.

0 → a
1 → $\bar{a}$ } M.

A	B	C	S	Cout	
0	0	0	0	0	m_0
0	0	1	1	0	$m_1 \Rightarrow C = C_{in}$.
0	1	0	1	0	m_2
0	1	1.	0	1	m_3 $\bar{a}bc$
1	0	0	1	0	m_4
1	0	1	0	1	$m_5 = a\bar{b}c$
1	1	0	0	1	$m_6 = ab\bar{c}$
1	1	1	1	1	$m_7 = abc$

$Cout = f(a,b,c) = \bar{a}bc + a\bar{b}c + ab\bar{c} + abc$

BCD DE 7 SEGMENTOS



nº	$\overline{BI}$	D	C	B	A	a	b	c	d	e	f	g
0	1	0	0	0	0	1	1	1	1	1	1	0
1	1	0	0	0	1	0	1	1	0	0	0	0
2	1	0	0	1	0	1	1	0	1	1	0	1
3	1	0	0	1	1	1	1	1	1	0	0	1
4	1	0	1	0	0	0	1	1	0	0	1	1
5	1	0	1	0	1	1	0	1	1	0	1	1
6	1	0	1	1	0	0	0	1	1	1	1	1
7	1	0	1	1	1	1	1	1	0	0	0	0
8	1	1	0	0	0	1	1	1	1	1	1	1
9	1	1	0	0	1	1	1	1	0	0	1	1
10	1	1	0	1	0	0	0	0	1	1	0	1
11	1	1	0	1	1	0	0	1	1	0	0	1
12	1	1	1	0	0	0	1	0	0	0	1	1
13	1	1	1	0	1	1	0	0	1	0	1	1
14	1	1	1	1	0	0	0	0	1	1	1	1
15	1	1	1	1	1	0	0	0	0	0	0	0
	0	X	X	X	X	0	0	0	0	0	0	0