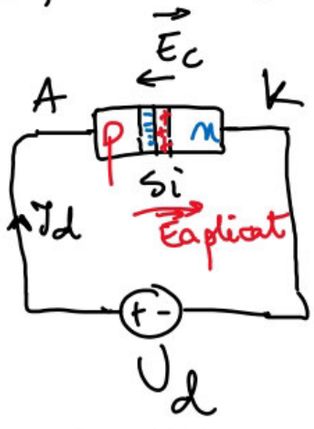
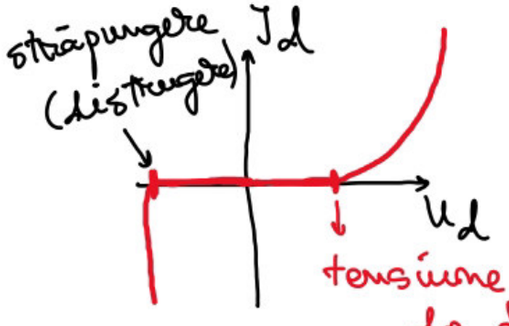
# Laborator nr. 3:

## Porți logice cu tranzistori:

porți - cu TB
      - cu TECMOS (MOSFET)

## Jonctiunea p-n:




Si intrinsec (nedopat)
- nr. egal de electroni și goluri

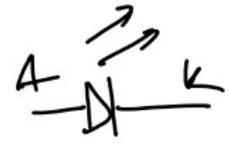
Si-p (dopat cu impuritați acceptoare)

goluri ca purtatori majoritari

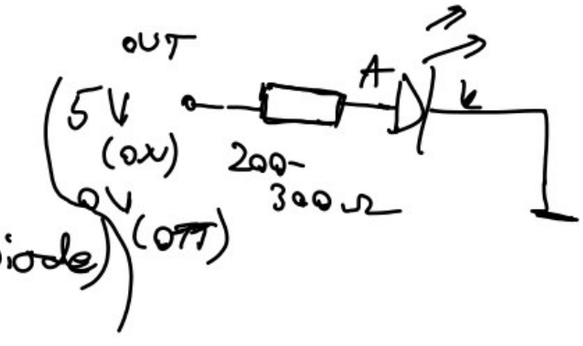
Si-n (dopat cu impuritați donoare)

electroni ca purtatori majoritari


diodă semiconductoare



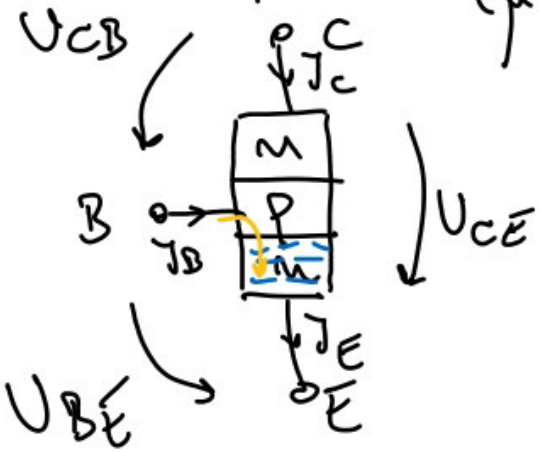

LED
(Light Emitting Diode)

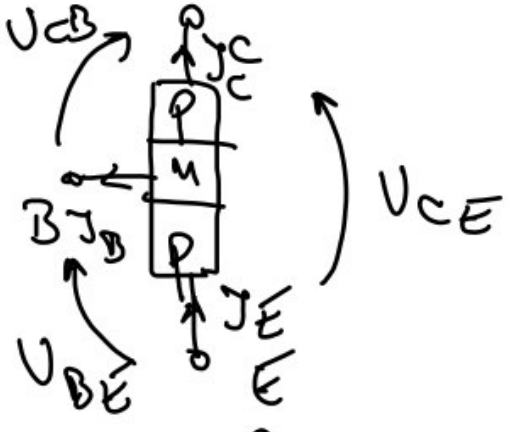


# Tranzistorul bipolar (TB, BJT) → porți TTL (Transistor-Transistor Logic)

- dispozitiv comandat în **curent**

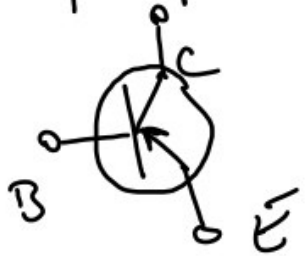
prin $I_B$ (mic) controlăm $I_C$ (mare)
($\mu A$) (mA)




NPN


PNP




$I_C \approx \beta \cdot I_B$ ; $I_E \approx I_C$

$\beta = 10 - 1000$

# Regimuri de funcționare ale TB:

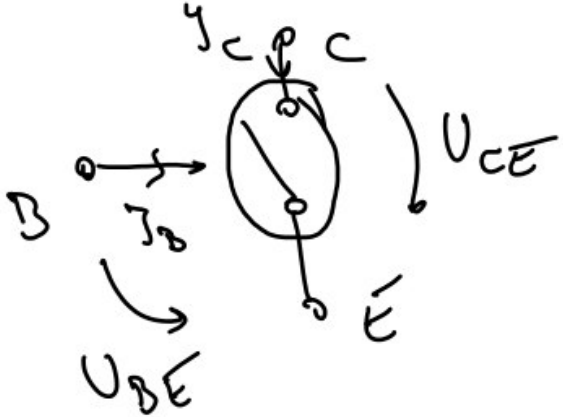
## blocat

joncțiunea BE nu este deschisă

$U_{BE} < 0.7V$

$I_B = 0 \Rightarrow I_C = 0$

$U_{CE} \geq E_C$




## saturat

$U_{BE} \simeq 0.7V$

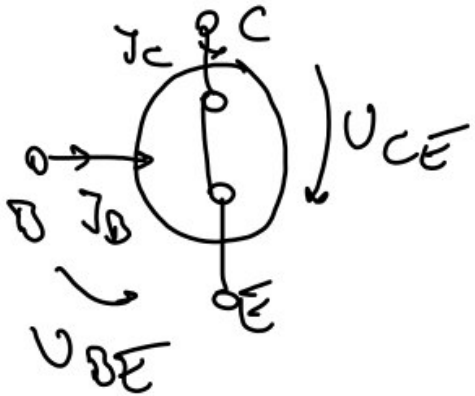
(BE deschis)

$I_B$ - f. mare

$I_C$ - maxim

$I_C < \beta \cdot I_B$

$U_{CE} \simeq 0 - 0.2V$

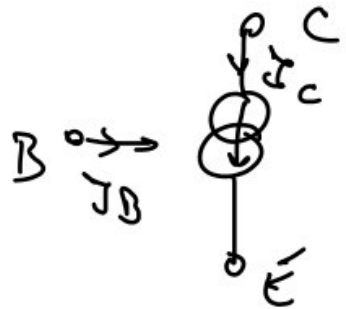



## activ (amplificator)

$U_{BE} \simeq 0.7V$

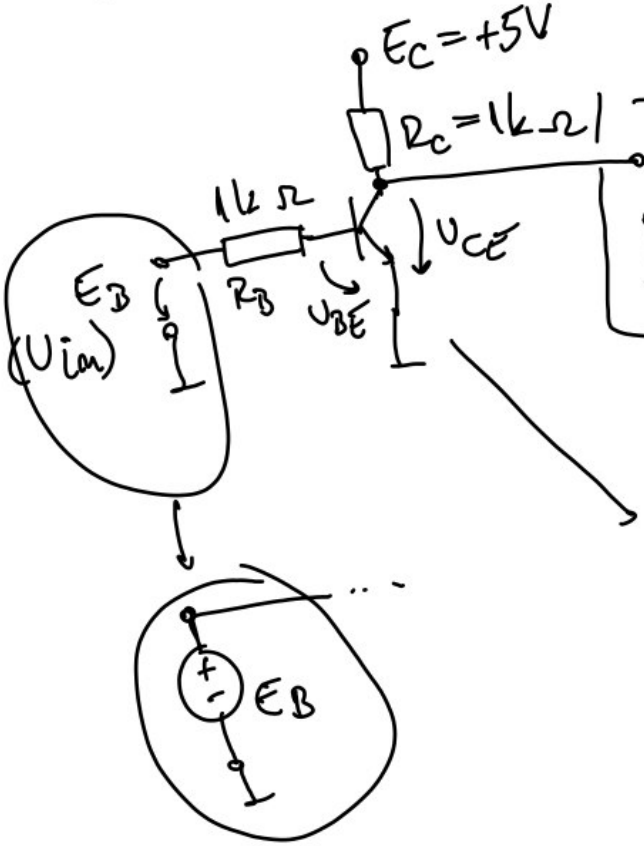
$I_B$ - mici mic
mici mare

$I_C \simeq \beta I_B$




$U_{CE} > 0$

# Porți logice cu TB:

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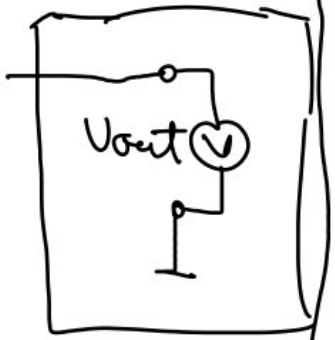
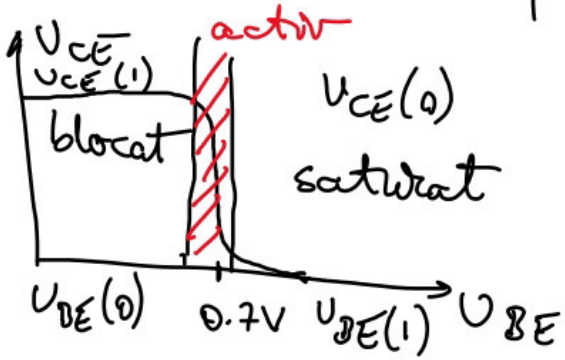



T blocat

| $V_{in}$ (V) | $V_{out}$ (V) |
|---|---|
| 0 | 5V |
| 5 | 0V |

T saturat




| IN | OUT |
|---|---|
| 0 | 1 |
| 1 | 0 |

⇒ INVERSOR.
„NOT".

# Porți TTL:

IN

0: 0 - 0.8V

1: 2 - 5V

OUT

0: 0 - 0.5V

1: 2.7 - 5V

Porți logice cu TECMOS:

TECMOS - dispozitive comandate în tensiune

$V_{GS}$ → controlăm $I_D$

$$V_{GS} = V_G - V_S$$

Poarta CMOS (a)

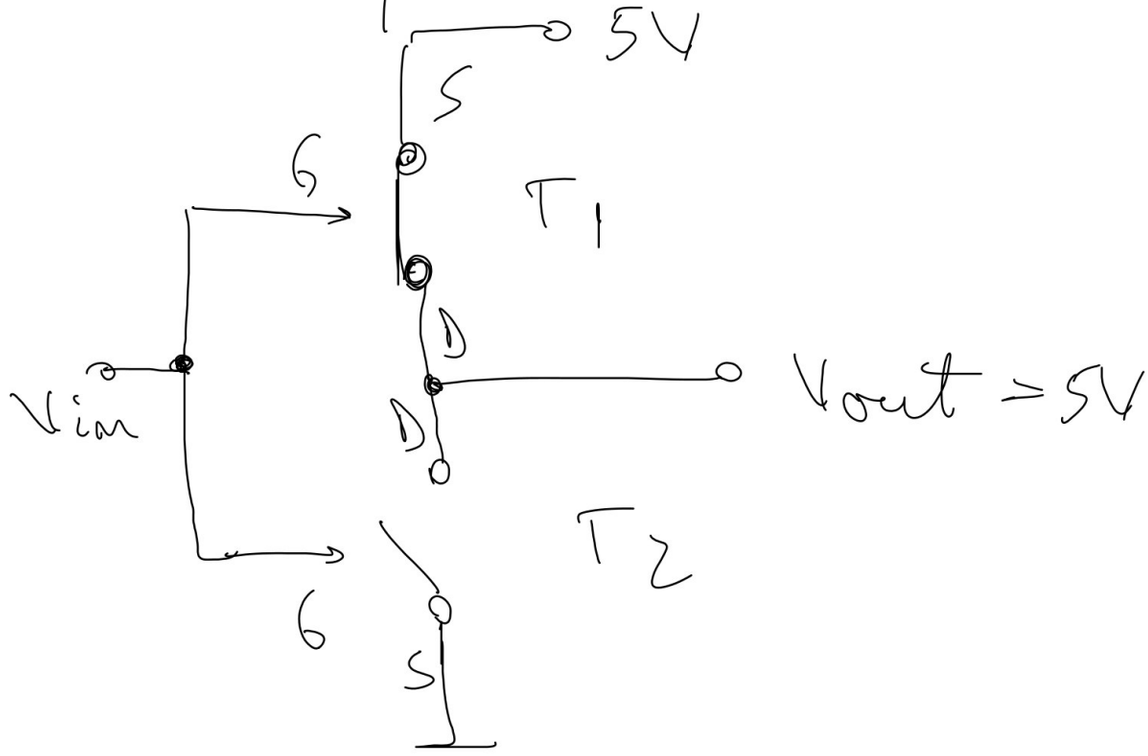
$T_1$ 0V

$V_{in} = 0V$

$T_1$: $V_{GS} = V_G - V_S = 0V - 5V = -5V < 0$

$T_2$: $V_{GS} = 0V - 0V = 0V \Rightarrow T_2 = 0$ ~~FF~~

Schemă echiv. pt. $V_{in} = 0V$

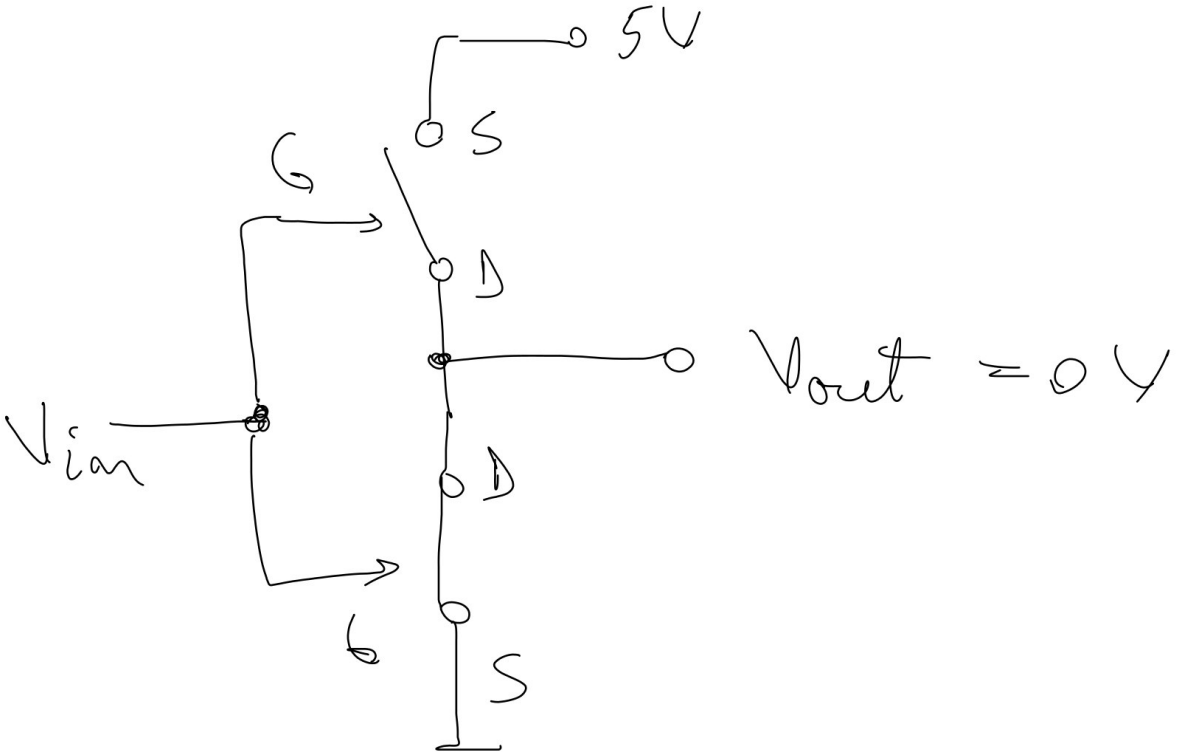


$V_{in} = 5V$

$T_1$: $V_{GS} = 5V - 5V = 0V \Rightarrow T_1 = OFF$

$T_2$: $V_{GS} = 5V - 0V = 5V \Rightarrow T_2 = ON$

Schema echiv. pt. $V_{in} = 5V$




| $V_{in}$ | $V_{out}$ | $T_1$ | $T_2$ |
|---|---|---|---|
| 0V | 5V | ON | OFF |
| 5V | 0V | OFF | ON |

NOT