Laborator nr. 3:

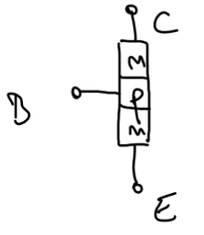
Tranzistorul bipolar:

tranzistor – permite controlul unui curent folosind un alt curent sau o tensiune

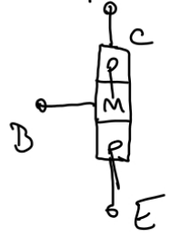
TB, BJT – „Bipolar Junction Transistor".

BJT – 2 joncțiuni pn sau np

BJT npn

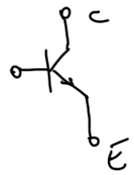


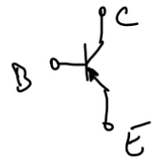
pnp



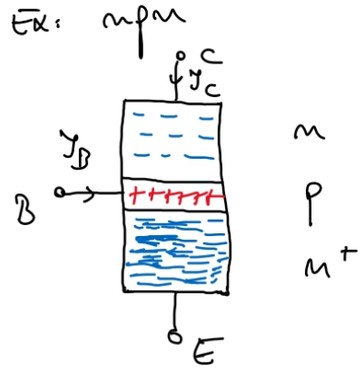
B – bază
C – colector
E – emitor

simboluri





Ex: npn



Regimuri de funcționare:

- switch electronic (blocat/saturat)
- sursă de curent controlabilă (activ)

tranzistor – cel mai simplu amplificator

BJT – dispozitiv comandat în curent

$I_B \rightarrow \mu A$

$I_C = \beta \cdot I_B$ $\quad I_C \rightarrow mA$

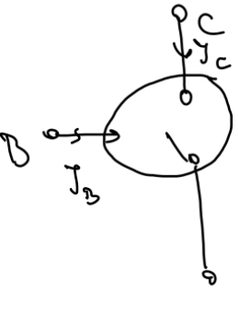
β – factorul de amplificare

small-signal: $\beta = 100 - 1000$

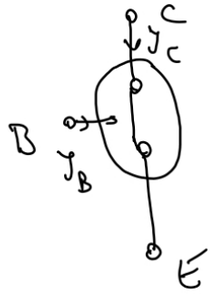
putere: $\beta = 2 - 10$

scheme echivalente:

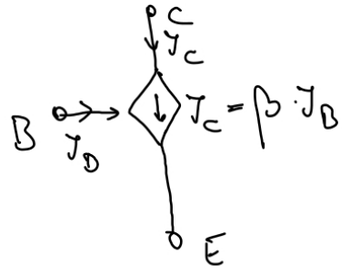
blocat

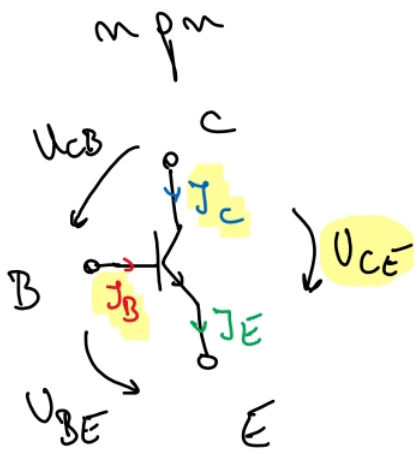


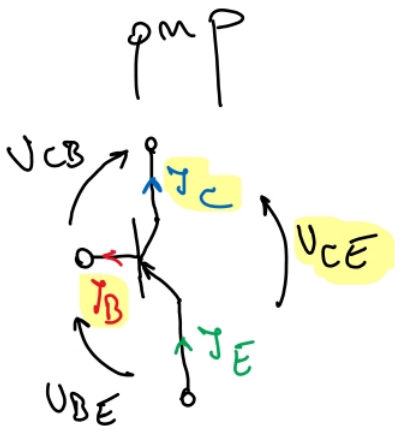
saturat



activă







Regimuri de funcționare (npn)

- blocat:

$U_{BE} < 0.7V \rightarrow I_B = 0 \rightarrow I_C = 0$

$U_{CE} = +E_C$

- activ

$U_{BE} \simeq 0.7V \rightarrow I_B > 0$

$I_C = \beta \cdot I_B$ (liniară)

$U_{CE} > 0$

- saturat

$U_{BE} \simeq 0.7V$

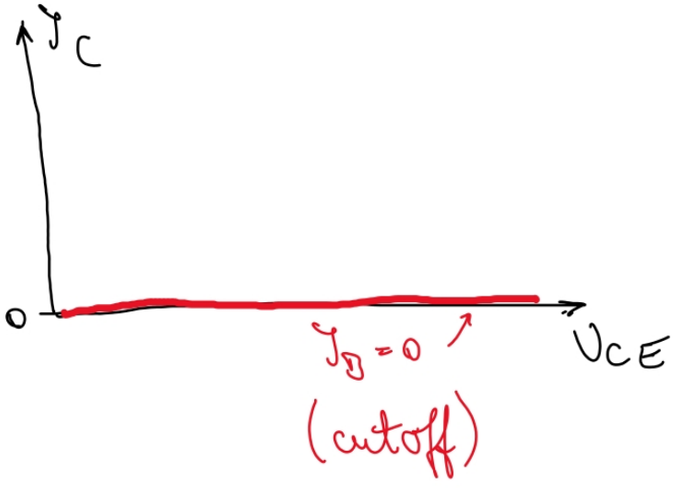
$I_B > 0$; $I_C \neq \beta \cdot I_B$

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

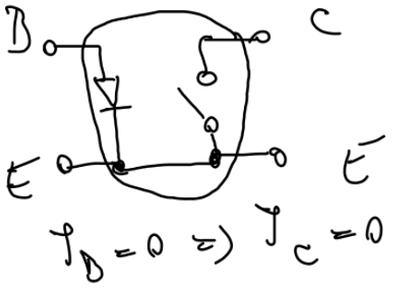
Caracteristica joncțiunii BE

joncțiunea BE → pn (diodă)

Caracteristicile colectorului: ($I_B = ct.$)

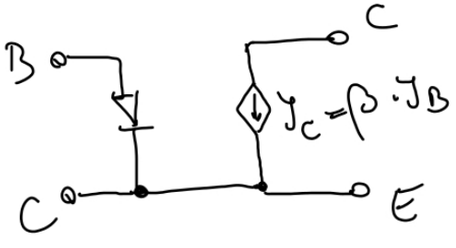


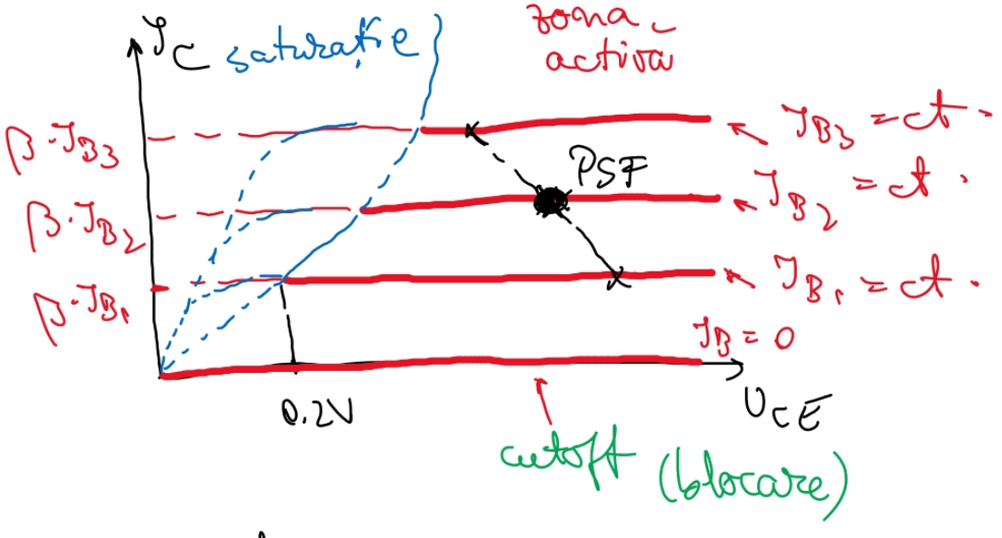
mod blocat:



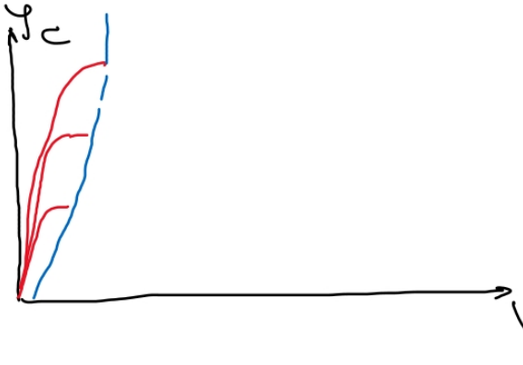
$I_B = 0 \Rightarrow I_C = 0$

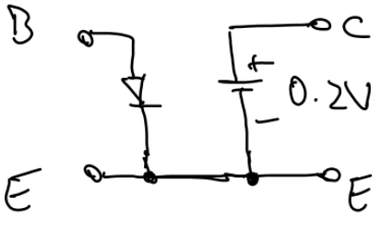
mod activ



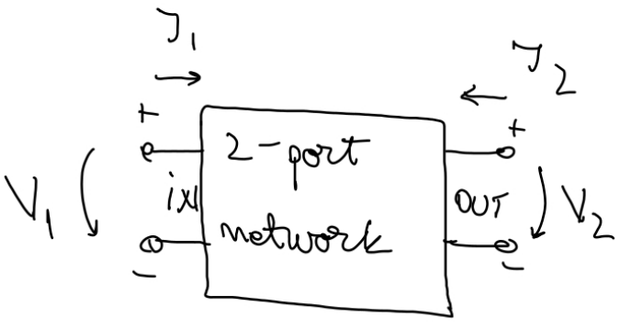


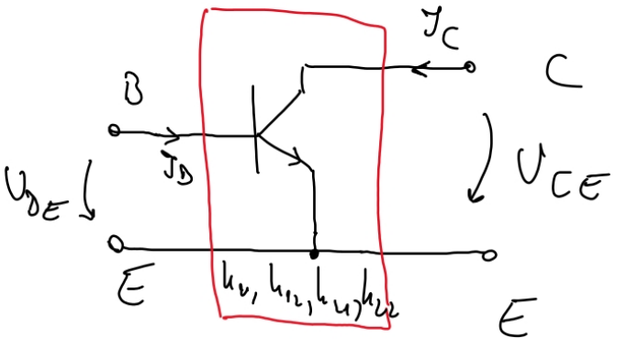
mod saturat:





Matricea hibridă:





$$\begin{pmatrix} V_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{pmatrix} \begin{pmatrix} I_1 \\ V_2 \end{pmatrix}$$

h_{ij} - det. din caract. circuitului

$$V_1 = h_{11} I_1 + h_{12} \cdot V_2$$

$$I_2 = h_{21} I_1 + h_{22} \cdot I_2$$

Definim

$$h_{11} = \left.\frac{V_1}{I_1}\right|_{V_2=0} = Z_{in}\ [\Omega] = h_{ie}$$

$$h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1=0} = \text{adim} = h_{re}$$

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} = \beta = h_{fe}\ (\text{adim})$$

$$h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0} = Y_{out} \rightarrow^{-1} (S) = \frac{1}{Z_{out}} = h_{oe}$$

$V_{CE}(V)$	$V_{BE}(V)$	$I_B(\mu A)$	$I_C(mA)$
5	0	0	0
5	0.054	0	0
...	...	...	..
5.005	0.504	0.06	0.004
5	0.600	1.302	0.2
...	...	...	...
4.998	0.650	8.101	1.432
;	;	;	;

$I_C = f(I_B)\Big|_{V_{CE}=ct.} \Rightarrow h_{ie}(h_{11})$

$I_B = f(V_{BE})\Big|_{V_{CE}=ct.} \Rightarrow h_{fe}(h_{21})$