Note Title 9/10/2016

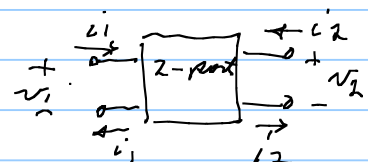
EE 303H

09/15/16

π equivalent circuit $i = Yv$

p. 718 for BJT & p. 714 for MOS

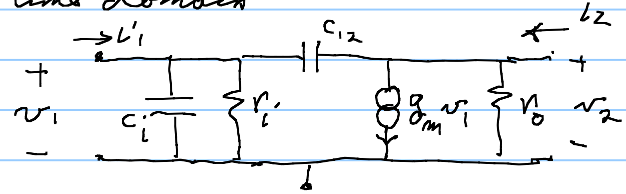
fig. 10.14(a) fig. 10.12 (b)



if linear $\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$

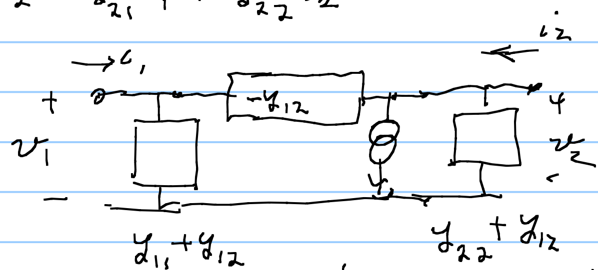
$p_{in} = v_1 i_1 + v_2 i_2 = v^T \cdot i$

in time domain



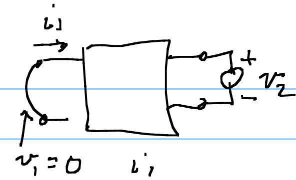
$$i_1 = y_{11} v_1 + y_{12} v_2$$

$$i_2 = y_{21} v_1 + y_{22} v_2$$

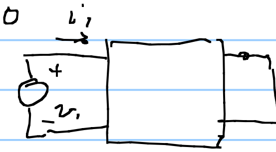


$i = (y_{21} - y_{12}) v_1$

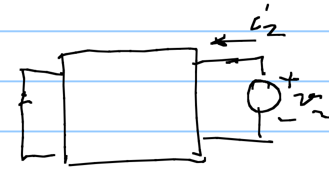
$$y_{12} = \frac{i_1}{v_2}\Big|_{v_1=0}$$



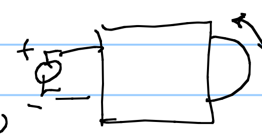
$$y_{11} = \frac{i_1}{v_1}\Big|_{v_2=0}$$

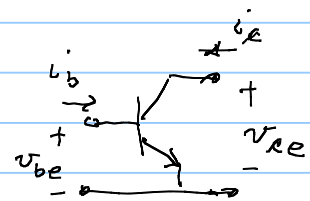


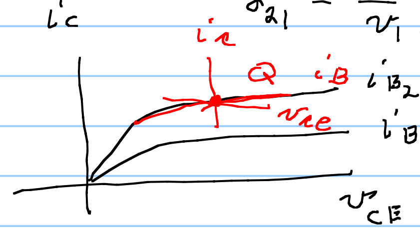
$$y_{22} = \frac{i_2}{v_2}\Big|_{v_1=0}$$



$$y_{21} = \frac{i_2}{v_1}\Big|_{v_2=0}$$



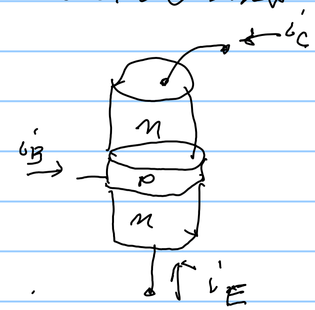




$$i'_C(v_{CE}, i'_B) = I_C + \left.\frac{\partial i'_C}{v_{CE}}\right|_Q (v_{CE} - V_{CE}) + \left.\frac{\partial i'_C}{\partial i'_B}\right|_Q (i'_B - I_B)$$

+ higher order terms

$$i'_c = (i'_C - I_c) = g_0\big|_Q \cdot v_{ce} + \beta\big|_Q \cdot i'_b$$



$i'_C + i'_B + i'_E = 0$ KCL

we have $i'_C = -\alpha i'_E$ $\alpha \lesssim 1$.

$i'_C = -\alpha i'_E = -i'_B - i'_E \Rightarrow$ $i'_E(1-\alpha) = -i'_B$

$= -\frac{1}{\alpha} i'_C(1-\alpha) \Rightarrow$ $i'_B = \frac{1-\alpha}{\alpha} i'_C$

$\Rightarrow i'_C = \frac{\alpha}{1-\alpha} i'_B$; $i'_C = \beta i'_B$, $\beta = \frac{\alpha}{1-\alpha} = \beta_{forward}$ = BETAF (Spice)

i'_B needs to be (here $i'_c = \beta i'_b$ with the same β)

found in terms of $v_1 = v_{be}$ & $v_2 = v_{ce}$ as in eq. in Y