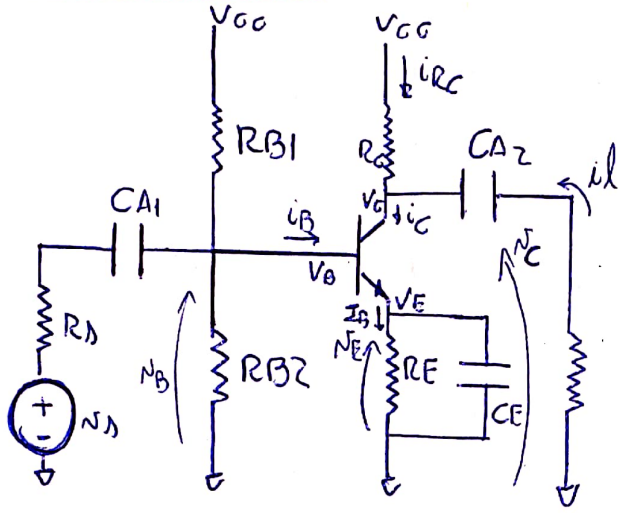
Ejercicio C-5

NTBJ : BC548B



$V_{CC} = 18V$

$R_C = 3K$

$R_E = 1K$

$R_L = 2K$

$R_{B1} = 600K$

$R_{B2} = 120K$

$\beta = [200, 450]$ 290 típico

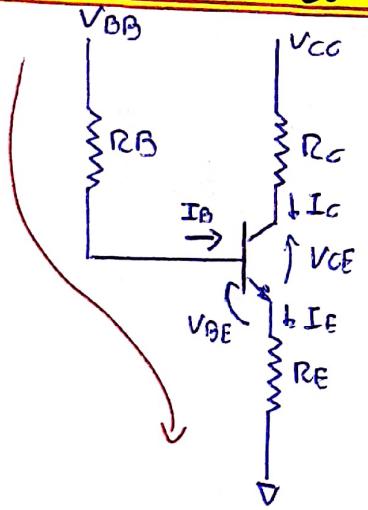
$V_{BE_{on}} = [0,55 ; 0,7]$

$V_{CEk} = 0,6$

$I_{Cmin} = 0,2m$

$R_S = 50\Omega$

Calculo de punto de reposo



$$V_{BB} = V_{CC} \cdot \frac{R_{B2}}{R_{B1} + R_{B2}} = 3V$$

$$R_B = \frac{R_{B1} \cdot R_{B2}}{R_{B1} + R_{B2}} = 100K\Omega$$

$$V_{BB} - I_B \cdot R_B - V_{BE} - I_C \cdot R_E = 0$$

$$V_{BB} - V_{BE} = I_C \left(R_E + \frac{R_B}{\beta} \right)$$

$$I_C = \frac{V_{BB} - V_{BE}}{R_E + \frac{R_B}{\beta}}$$

Considerando solo dispersion del β

$V_{BE} = 0,7$

$$I_{CQMAX} = \frac{V_{BB} - V_{BE}}{R_E + \frac{R_B}{\beta_{MAX}}} = 1,88mA$$

$$I_{BQmin} = \frac{V_{BB} - V_{BE}}{\beta_{MAX} R_E + R_B} = 4,2\mu A$$

$$I_{CQmin} = \frac{V_{BB} - V_{BE}}{R_E + \frac{R_B}{\beta_{min}}} = 1,53mA$$

$$I_{BQMA} = \frac{V_{BB} - V_{BE}}{\beta_{min} \cdot R_E + R_B} = 7,7\mu A$$

Considerando solo dispersion V_{BE}

$\beta = 290$

$$I_{CQ\,max} = \frac{V_{BB} - V_{BE\,min}}{R_E + \frac{R_B}{\beta}} = 1{,}82\,mA \qquad I_{BQ\,MAX} = \frac{V_{BB} - V_{BE\,min}}{\beta R_E + R_B} = 6{,}3\,\mu A$$

$$I_{CQ\,min} = \frac{V_{BB} - V_{BE\,MAX}}{R_E + \frac{R_B}{\beta}} = 1{,}71\,mA \qquad I_{BQ\,min} = \frac{V_{BB} - V_{BE\,MAX}}{\beta R_E + R_B} = 5{,}9\,\mu A$$

considerando dispersion de β y V_{BE}

$$I_{CQMAX} = \frac{V_{BB} - V_{BE\,min}}{R_E + \frac{R_B}{\beta_{MAX}}} = 2\,mA \qquad I_{CQ\,min} = \frac{V_{BB} - V_{BE\,MAX}}{\beta_{MAX} R_E + R_B} = 4{,}7\,\mu A$$

$$I_{Q\,min} = \frac{V_{BB} - V_{BE\,MAX}}{R_E + \frac{R_B}{\beta_{min}}} = 1{,}53\,mA \qquad I_{CQ\,MAX} = \frac{V_{BB} - V_{BE\,min}}{\beta_{min} R_E + R_B} = 8{,}7\,\mu A$$

considerando parametros tipicos

$\beta = 290 \qquad V_{BE} = 0{,}63$

$$I_{CQ} = \frac{V_{BB} - V_{BE}}{R_E + \frac{R_B}{\beta}} = 1{,}76\,mA \qquad I_{BQ} = \frac{V_{BB} - V_{BE}}{\beta R_E + R_B} = 6{,}08\,\mu A$$

$I_{CQ} \gg I_{BQ}$

$$V_E = I_{EQ} \cdot R_E \tilde{=} I_{CQ} \cdot R_E = 1{,}76\,V$$

$$V_C = V_{CC} - I_C \cdot R_C = 12{,}72\,V$$

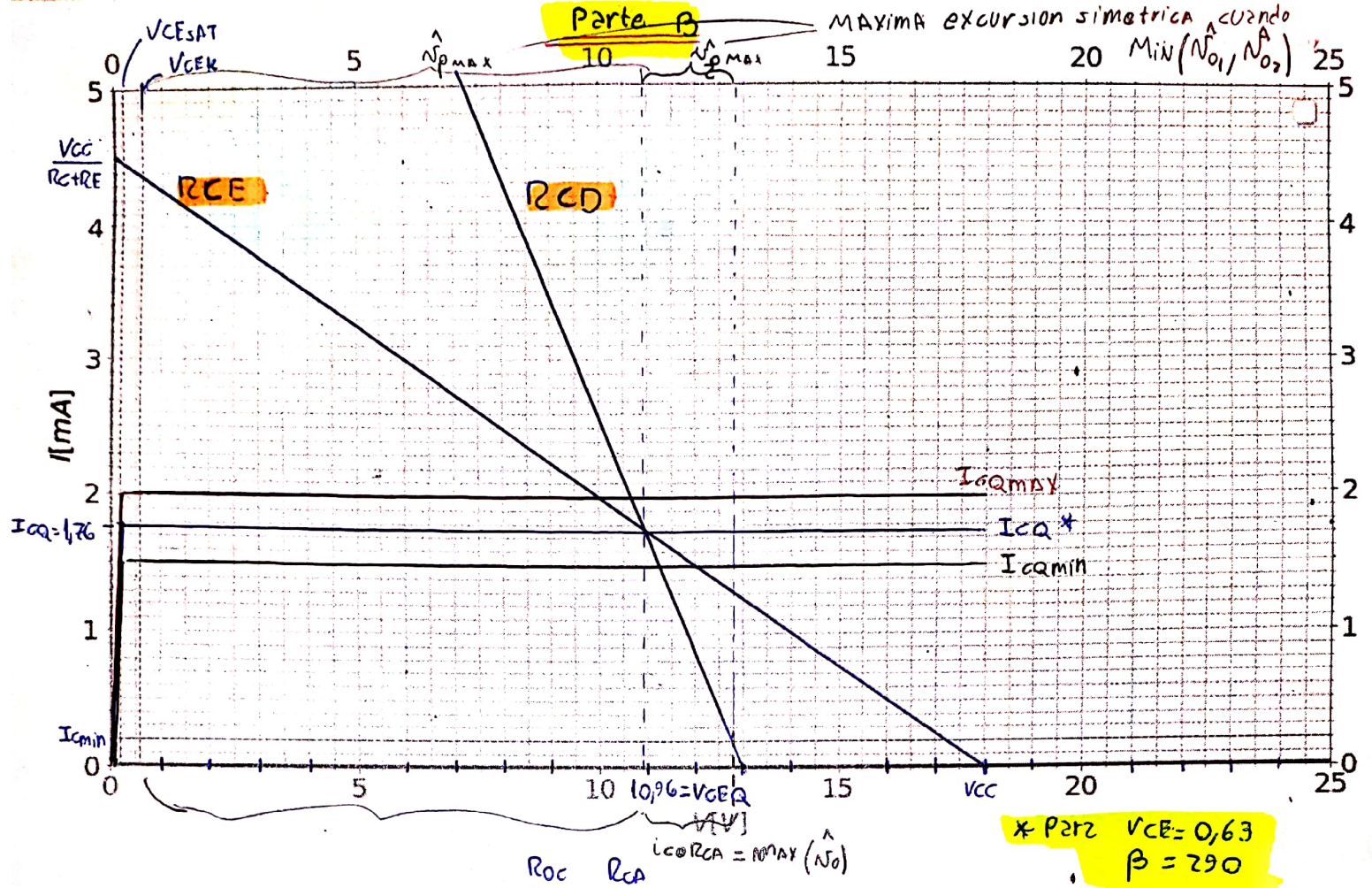
$$V_B = I_{EQ} \cdot R_E + V_{BE} = 2{,}39\,V$$

Calculo de V_{CEQ}

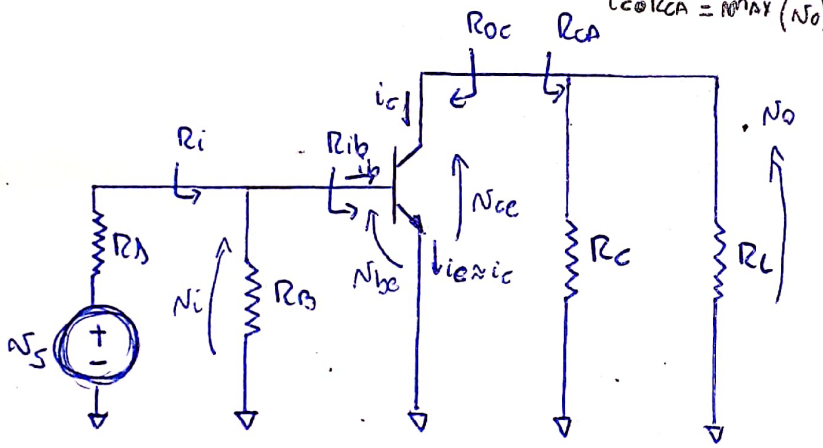
$$V_{CC} - I_{CQ} R_C - V_{CEQ} - I_E \cdot R_E = 0$$

$$V_{CC} - I_{CQ}\left(R_C + R_e\left(1 + \tilde{\frac{1}{\beta}}\right)\right) = V_{CEQ}$$

$$V_{CEQ} = 10{,}96\,V$$



* Para $V_{CE} = 0,63$, $\beta = 290$



$R_{CA} = R_C // R_L$

$R_{CA} = 1,2 K\Omega$

$g_m = \frac{I_{CQ}}{V_{th}} = 68\ mS\ imes$

$r_\pi = \frac{\beta}{g_m} = 4,3K$

$N_{ce} + i_c \cdot R_{CA} = 0$

Pendiente RCD $\nwarrow -\frac{N_{ce}}{R_{CA}} = i_c$

RCD: $I = -\frac{V}{1,2k} + 10,9mA$

$V|_{i_{min}=0,2mA} \Rightarrow 0,2mA = -\frac{V_{icmin}}{1,2k} + 10,9mA$

$V_{icmin} = 12,84V$

Parte C

$\hat{N}_{o1} = |V_{CEQ} - V_{CEK}| = |10,96V - 0,6V| = 10,36V$

$\hat{N}_{o2} = |V_{CEQ} - V_{icmin}| = |10,96V - 12,84| = 1,88V$

$\hat{N}_{oMAX} = Min[10,36V, 1,88V] = 1,88V$

$N_{oeff} = N_{ceeff} = \frac{1,88V}{\sqrt{2}} = 1,33V$

Parte D

$$\frac{v_o}{v_i} = A_v = -\frac{g_m \cdot \cancel{v_{be}}^{v_i} \cdot R_{CA}}{\cancel{v_i}} = -68m_S \cdot 1{,}2K = 81{,}6$$

$$v_o = -g_m \cdot \overset{v_i}{v_{be}} \cdot R_{CA}$$

$$v_i = -\frac{v_o}{g_m \cdot R_{CA}} \quad \text{Para } v_{o_{MAX}} \Rightarrow |\hat{v}_{i_{MAX}}| = \left|\frac{1{,}88V}{68m \cdot 1{,}2K}\right|$$

$$\hat{v}_{i_{MAX}} = 23{,}04mV < V_{TH}$$

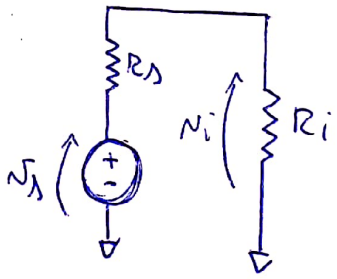
Aunque es comparable Por lo que va haber Problemas de Alinealidad

$$v_{i_{EFF_{MAX}}} = \frac{23{,}04mV}{\sqrt{2}} = 16{,}29mV$$

Parte e

$R_{ib} = r_\pi = 4{,}3K \qquad R_B = 100K$

$R_i = R_{ib} // R_{ib} = 4{,}12K$



$$v_i = v_S \cdot \frac{R_i}{R_i + R_S}$$

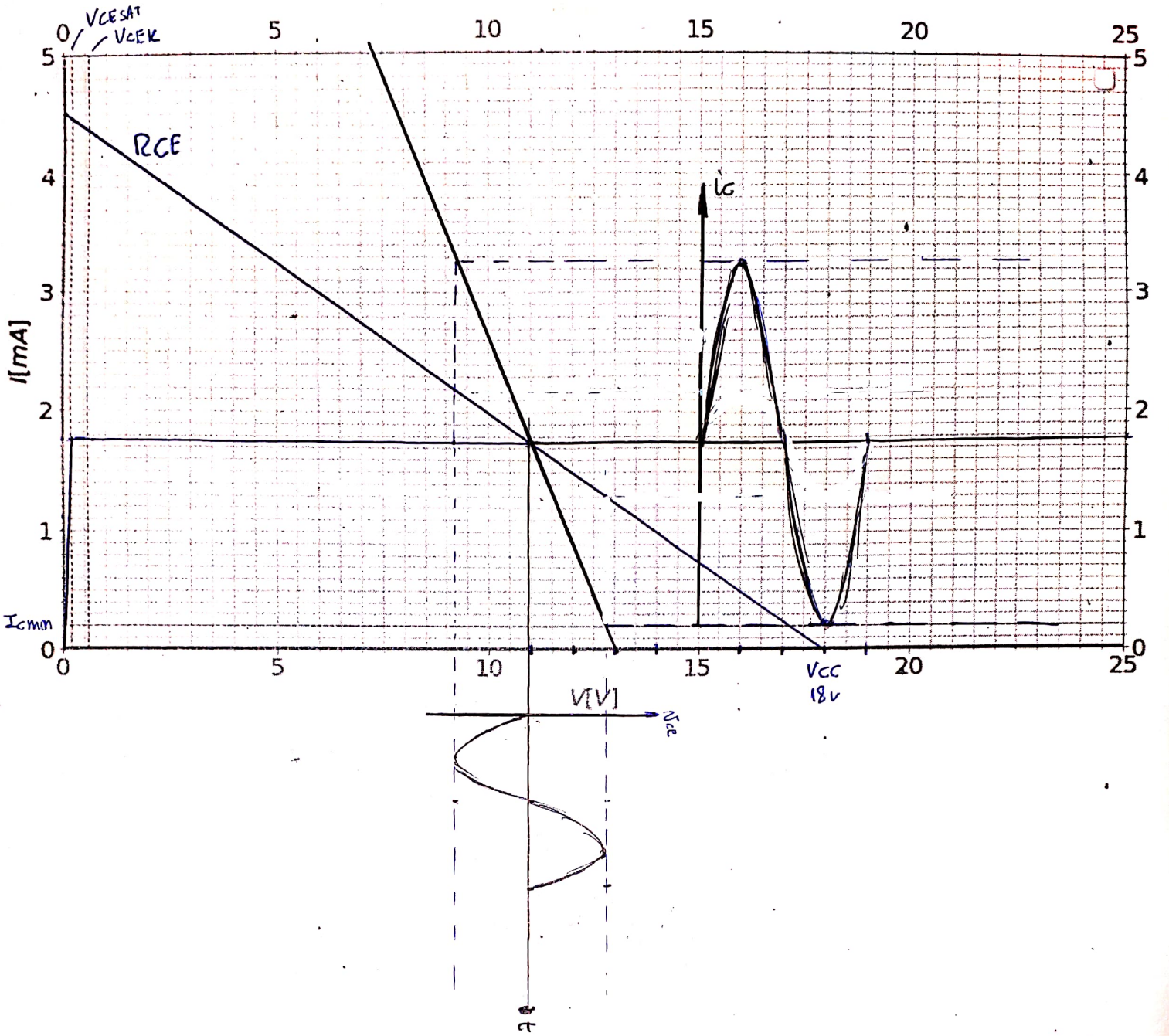
$$v_S = v_i \cdot \frac{R_i + R_S}{R_i}$$

Para $v_{i_{MAX}} = 23{,}04mV$

$$\hat{v}_S = 23{,}04mV \cdot \frac{4{,}12K\Omega + 50\Omega}{4{,}12K}$$

$$\hat{v}_S = 23{,}32mV$$

$$v_{S_{EF}} = \frac{23{,}32mV}{\sqrt{2}} = 16{,}5mV$$


VCESAT
VCEK
RCE
Ic
I[mA]
Icmin
V[V]
Vce
Vcc
18v
0
5
10
15
20
25
1
2
3
4

PARTE F