LISTA 3 - EE530

DADOS:

(1) $V_T = 26mV$

(2) $I_{C1} = I_{C2}$

(3) $V_{BE1} - V_{BE2} = 20mV$

$$I_C \approx \frac{A_{EQ} D_n n_i^2}{N_E W_B} \cdot e^{\frac{V_{BE}}{V_T}}$$

De (2)

$$\frac{A_{E1}\left(q \cdot D_n \cdot n_i^2\right)}{N_E W_B} \cdot e^{\frac{V_{BE1}}{V_T}} = A_{E2} \cdot \frac{q D_n n_i^2}{N_E \cdot W_B} \cdot e^{\frac{V_{BE2}}{V_T}}$$

$$\Rightarrow \frac{A_{E2}}{A_{E1}} = \frac{e^{V_{BE1}/V_T}}{e^{V_{BE2}/V_T}} = e^{(V_{BE1}-V_{BE2})/V_T} = e^{\frac{20mV}{26mV}}$$

$$\boxed{\frac{A_{E2}}{A_{E1}} \approx 2,16}$$

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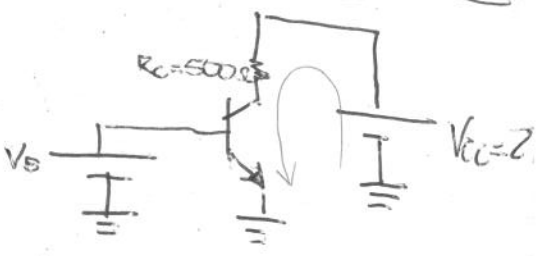
(9) EDGE OF ACTIVE REGION → $\boxed{V_C = V_B}$



$$V_{CC} = R_C (I_C) + (V_C)$$

$$V_{CC} = R_C I_S e^{V_B/V_T} + (V_B)$$

$$V_{CC} = 500 \cdot 5.10^{-16} \cdot e^{V_B/26mV} + V_B = 2V$$

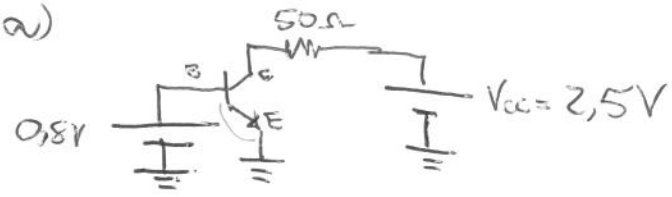
POR MÉTODOS NUMÉRICOS

$$\boxed{V_B \approx 760mV}$$

4.21)

$V_A \to \infty \therefore r_o \to \infty \quad I_S = 8.10^{-16}\,A \quad \beta = 100$

a)



$V_{BE} = 0,8V \to I_C = I_S \cdot e^{V_{BE}/V_T} \to I_C = 18,5\,mA$

$V_{CE} = V_{CC} - R_C I_C \to V_{CE} = 1,58V$

$\therefore$ modo ativo

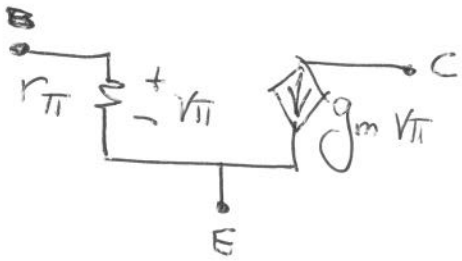
→ Parâmetros de pequenos sinais

$g_m = I_C/V_T = 710\,m1/\Omega$

$r_\pi = \beta/g_m = 141\,\Omega$

$r_o \to \infty$

DESENHO MODELO π-HÍBRIDO



b) $I_B = 10\,\mu A$

$I_C = \beta I_B = 1mA$

$V_{BE} = V_T \ln(I_C/I_S) = 724mV$

$V_{CE} = V_{CC} - R_C I_C = 1,5V$

$\therefore$ modo ativo

Para Pequenos sinais

$g_m = I_C/V_T = 38,5$

$r_\pi = \beta/g_m = 2,6K\Omega$

$r_o \to \infty$

c) $I_E = \frac{V_{CC} - V_{BE}}{R_C} = \frac{1+\beta}{\beta} I$

$I_C = \frac{\beta}{\beta+1} \frac{V_{CC} - V_T \ln(I_C/}{R_C}$

$I_C = 1,7\,mA$

$V_{BE} = V_T \ln(I_C/I_S) = 739,$

MODO ATIVO

$g_m = I_C/V_T = 38,5m$

$r_\pi = \beta/g_m = 2,6K\Omega$

$r_o = \infty$

(29)

a) Sendo $I_C = 1mA$ $V_B = ?$

$I_C = I_S\, e^{V_B/V_T} \rightarrow V_B = V_T \ln(I_C/I_S)$

$V_B = 26mV \ln(10^{-3}/3.10^{-17})$

$\boxed{V_B \approx 809,6mV}$

(3)

$V_A = 5V$
$V_{CE} = 1,5V$
$I_C = 1mA$
$V_B = ?$

Considerando V_A

$I_C = I_S\, e^{V_B/V_T}\left(1 + \frac{V_{CE}}{V_A}\right)$

$10^{-3} = 3.10^{-17} \cdot e^{V_B/V_T}\left(1 + \frac{1,5}{5}\right)$

$e^{V_B/V_T} = \frac{10^{14}}{3,9}$

$V_B = 26mV \ln\left(\frac{10^{14}}{3,9}\right)$

$\approx 802,8\,mV$

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(37) $I_{S1} = 3I_{S2} = 6.10^{-16}A$

$I_1 = I_{S1} \cdot \exp\left(\frac{V_{BE1}}{V_T}\right) = 6.10^{-16} \cdot \exp\left(\frac{300}{26}\right) \rightarrow I_1 = 6,155.10^{-11}$

$I_2 = I_{S2} \exp\left(\frac{V_{EB2}}{V_T}\right) = 2.10^{-16}\left(\frac{820}{26}\right) \rightarrow I_2 \approx 10mA$

$I_X = I_1 + I_2 \approx 10mA$

4.44) $I_S = 3 \cdot 10^{-17} A$; $\beta = 100$ $V_A = \infty \rightarrow r_o \rightarrow \infty$

a) $I_B = 2\mu A$

$I_C = \beta I_B = 200\mu A$

$V_{EB} = V_T \ln(I_C/I_S) = \boxed{768mV}$

$V_{EC} = V_{CC} - I_E \cdot (2K) = V_{CC} - \left(\frac{1+\beta}{\beta}\right) I_C \cdot (2K) \neq \boxed{2,1V}$

∴ MODO ATIVO

$g_m = I_C/V_T = 7,69mS$

$r_\pi = \beta/g_m = 13K\Omega$

b) $I_E = \frac{V_{CC} - V_{EB}}{5K} \rightarrow \left(\frac{1+\beta}{\beta}\right) I_C = \frac{V_{CC} - V_T \ln(I_C/I_S)}{5K}$

∴ $I_C = 340\mu A$

$V_{EB} = 782mV$

$V_{EC} = V_{EB} = 782mV$

MODO DIRETO

$g_m = I_C/V_T = 13,1mS$

$r_\pi = \beta/g_m = 7,64 K\Omega$

CONT DO ITEM "C"

$g_m = \frac{I_C}{V_T} = 19mS$

$r_\pi = \beta/g_m = 5,25K$

c) $I_E = \frac{1+\beta}{\beta} I_C = 0,5mA \rightarrow I_C = 495\mu A$

$I_C = 495\mu A$

$V_{EB} = 971mV$ → FORMULA

$V_{EC} = V_{EB} = 971mV$