Aplicada II.

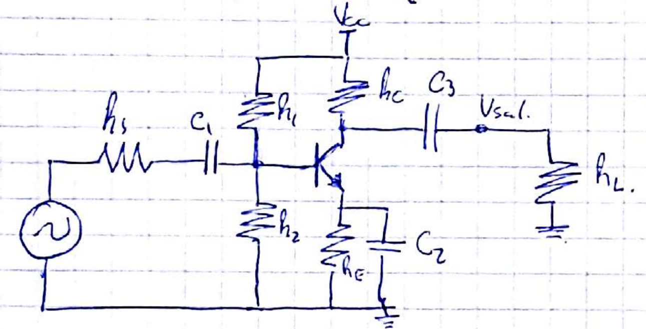
Respuesta en Frecuencia.

(2)

Determinar:

- f_h
- A_{Vm}.
- La resp. en baja frec. Con polo dominante el del capacitor de emisor. Para una frec. de corte inferior: $f_c = 20\ Hz$.

$R_1 // R_2 = 3872,66$



$R_S = 600\ \Omega$. $R_L = 2,2K\ \Omega$.

$R_1 = 22K\ \Omega$. $C_1 = 10\mu F$.

$R_2 = 4,7K\ \Omega$ $C_2 = 10\mu F$

$R_C = 2,2K\Omega$. $C_3 = 10\mu F$

$R_E = 470\ \Omega$. $V_{cc} = 10V$.

$h_{fe} = 125$ $C_{bc} = 2,4pF$.

$r_{bb} = 30\Omega$. $C_{be} = 20pF$.

+ resistencia de dispersión de Base emisor.

$$V_B = \frac{R_2}{R_1 + R_2} \cdot V_{cc} = 1,76\ V$$

$$V_E = V_B - 0,7 = 1,06\ V$$

$$I_E = \frac{V_E}{R_E} = 2,26\ mA$$

$$\boxed{r'_e = \frac{25mV}{I_e}} = 11,08$$

resistencia interna de emisor para alterna.

$$R_{ent(tot)} = R_S // R_1 // R_2 // \underbrace{\beta_{ca} \cdot r'_e}_{\approx hie} = 378.$$

colector.

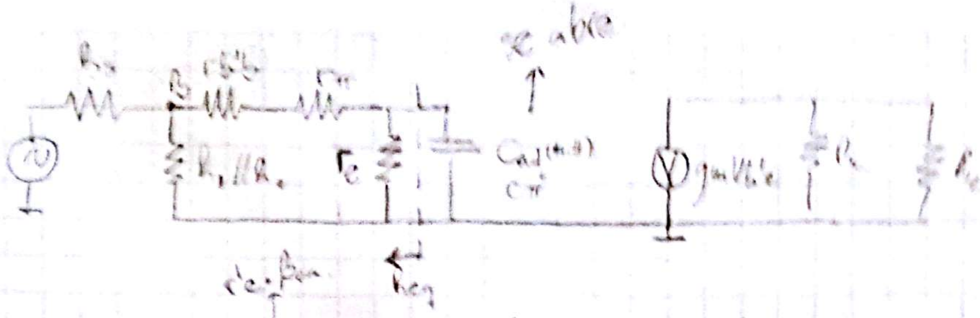
$$A_{v\,med} = \frac{R_C}{r'_e} = \frac{R_C // R_L}{r'_e} = 99,26.$$

¿Salida sobre entrada? Porque en el denominador solo esta r'_e

$$C_{ent\,(Miller)} = C_{bc}\,(A_{vm} + 1) = 240\ pF.$$

$$C_{ent\,(total)} = C_{ent\,(mill)} + C_{be} = 260,6\ pF.$$

$$f_h = \frac{1}{2\pi \cdot R_{ent\,(tot)} \cdot C_{ent\,(tot)}} = 1,616\ MHz$$



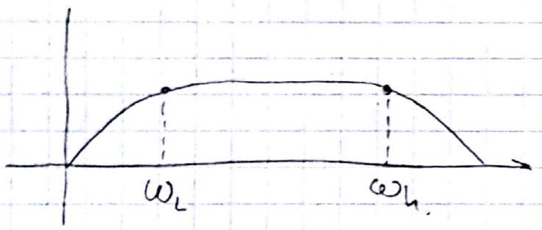
$$R_{eq} = r_e \,//\, \Big[\underbrace{(r_\pi + r_{b'b})}_{h_{ie}} \,//\, \big((R_1 // R_2) // R_s\big) \Big]$$

$$= 470 \,//\, \big[(1383 + 30) \,//\, (3872 \,//\, 600) \big]$$

$$= 470 \,//\, \big[1415 \,//\, 519 \big]$$

$$= 470 \,//\, 380 = 210 \quad R_{eq}$$

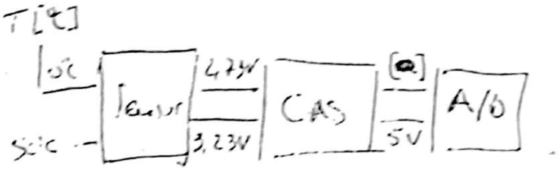
$$\omega_L = \frac{1}{210 \cdot 10\mu} = 476 \text{ Hz.}$$



Aplicación II

26/04/16

TP4 CAS (Simular).



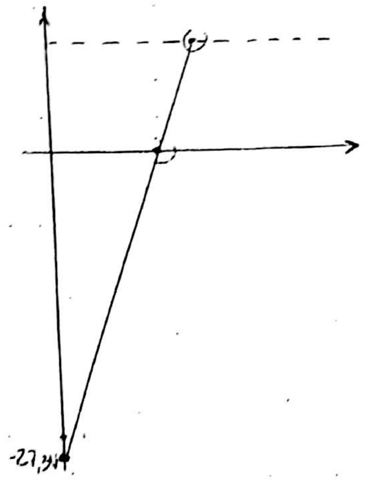
LM35 (sensor temp)

$V_{T°K} = 10mV/°K \cdot T_{in}[°K]$

$V_{T°C} = 10mV/°C \cdot T_{in}[°C] + 2,73V$

$V_{T0°C} = 10mV/°C (0°C)\ 2,73V = 2,73V$

$V_{T(50°C)} = 10mV/°C \cdot (50°C) + 2,73V = 3,23$



$m = \frac{\Delta Y}{\Delta x} = \frac{0-5V}{2,73-3,23V} = \frac{5}{0,5} = 10.$

$Y = mx + n.$

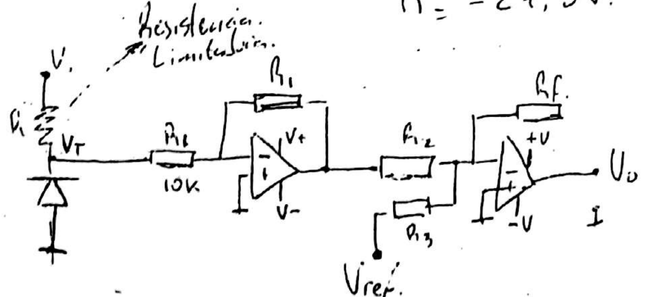
$V_o = m V_T + n$

$V_o = 10 V_T + n.$

$0 = 10 \cdot 2,73 + n.$

$n = -27,3V.$

$\boxed{V_o = 10V_T - 27,3V.}$



$\boxed{R_1} = 10K$

$\boxed{Rf} = 100K$

$$V_o = \underbrace{\left(-\frac{Rf}{R_{12}}\right)\cdot\left(-\cancel{\frac{R_1}{R_1}}\right)}_{10} \cdot V_T - \underbrace{\left(\frac{Rf}{R_{13}}\right)}_{27,3} \cdot V_{ref}.$$

$\boxed{R_{12}} = \frac{Rf}{10} = 10K.$

$27,3 = \frac{100K}{R_{13}} \cdot 15$

$\boxed{R_{13}} = 54,95K.$

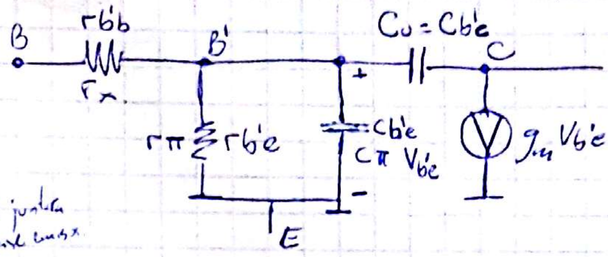
$V_o(0°C) = \frac{100k}{10k} \cdot 2,73 - \frac{100k}{54,95} \cdot 15$

$V_o(0°C) = 2,15mV \approx 0V$

$V_o(50°C) = \frac{100k}{10k} \cdot 3,23 - \frac{100k}{54,95} \cdot 15$

$= 5,002 V$

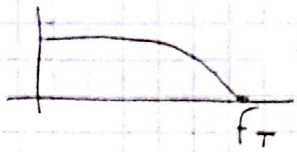
Respuesta en Frecuencia (Alta)



f_T = frec. de ganancia unitaria

↓

El amplificador tiene ganancia 1



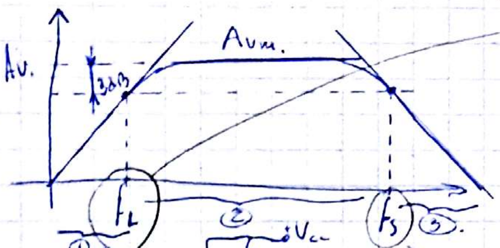
pendiente juntura base emisor

$h_{ie} \simeq r_\pi = \dfrac{h_{fe}}{g_m} = \dfrac{25mV \cdot h_{fe}}{I_{eq}}$; $g_m = 40\, I_{eq}$

$r_\pi + r_{b'b}$; r'_e

$C_\pi = \dfrac{g_m}{\omega_T}$; $\omega_T = \dfrac{g_m}{C_\pi + C_u}$

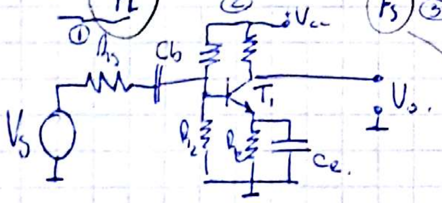
$r_{b'b} \simeq 10 - 50\Omega$



frec. crítica inferior (valor más alto)

↓

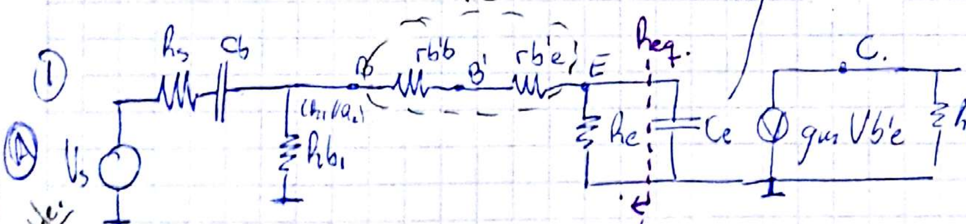
Porque es por donde por 1era vez comienza a reducirse la frec.

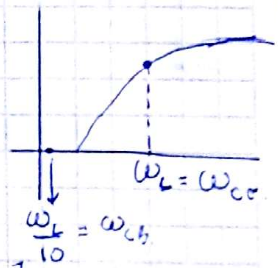


frec. crítica superior (valor en frec. más bajo)

capacidad de emisor.

hie



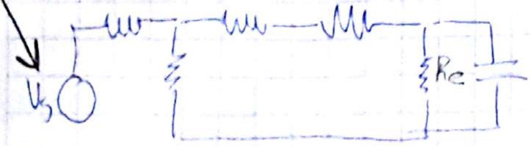


Cb es un cable.

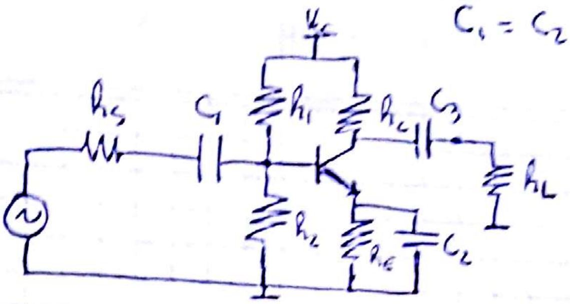
$$\boxed{\omega_L = \frac{1}{R_{eq} \cdot C_e}} \longrightarrow R_{eq} = \underline{R_e \,//\, \dfrac{r_{b'e} + r_{b'b} + [R_{b1} // R_s]}{(h_{fe}+1)}}$$

hie

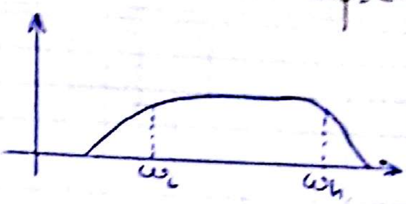
$(h_{fe}+1)$ → Se coloca porque está reflejado.



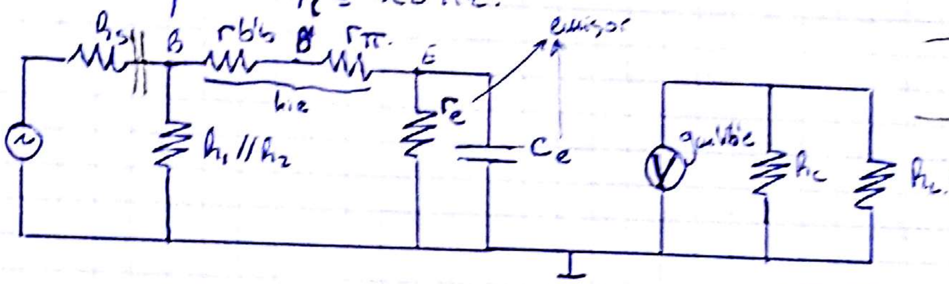
$\omega = 2\pi \cdot f$

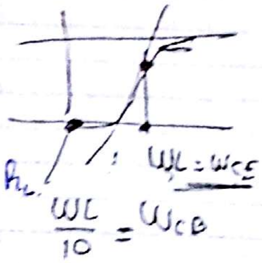


$C_1 = C_2 = C_3 = 10\,\mu F$ $\quad \omega_{CB} = \dfrac{\omega_L}{10} = \dfrac{1}{R_{eq}\cdot C_L}$



• Calcular la respuesta en baja frecuencia tomando como polo dominante el del capacitor de emisor (C_E) para una frecuencia de corte inferior $f_L = 20\,Hz$.





$$R_{eq} = r_e \,//\, \frac{[(r\pi + rb'b) + (R_1 // R_2 // R_S)]}{hfe + 1}$$

$$= 470 \,//\, \frac{[(1383+30)+(3372 // 600)]}{126}$$

$R_{eq} = 15\,\Omega$ *

$$\omega_L = \frac{1}{15 \cdot 10\mu} = 6716 \text{ rps.}$$

$\omega = 2\pi f = 2\pi \cdot 20\,Hz = 125$ rps

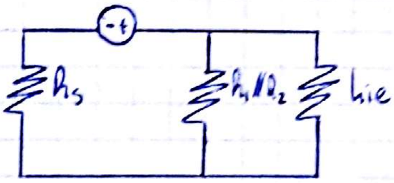
$\omega = \dfrac{1}{\tau} \therefore \tau = \dfrac{1}{125} = 7{,}96\cdot 10^{-3}$

$R_{eq}\cdot C_e = 7{,}96\cdot 10^{-3}$

$C_e = \dfrac{7{,}96\cdot 10^{-3}}{15} = 530\,\mu F$

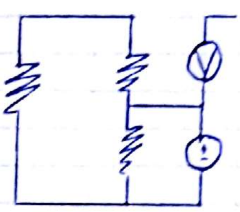
$\omega_L = 208$ rps

Para C_1: Abro C_1 y corto circuito C_2 y C_3.



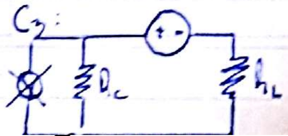
$R_{C_1} = [hie // (R_1 // R_2)] + R_S = 1636\,\Omega$.

Para C_2: Abro C_2 y corto circuito C_1 y C_3:



* $R_{C_2} = 15\,\Omega$.

Para C_3:



$R_{C_3} = R_C + R_L = 4{,}4\,K$.

$\tau_{C_1} = R_{C_1}\cdot C_1 = 16{,}36\,m$.

$\tau_{C_2} = R_{C_2}\cdot C_2 = 150\,\mu$.

$\tau_{C_3} = R_{C_3}\cdot C_3 = 44\,m$.

$$\omega_L = \frac{1}{\tau_{C_1}} + \frac{1}{\tau_{C_2}} + \frac{1}{\tau_{C_3}}$$

$\omega_L = 6750$ rps.

$\dfrac{\omega_L}{10} = 675$ rps.

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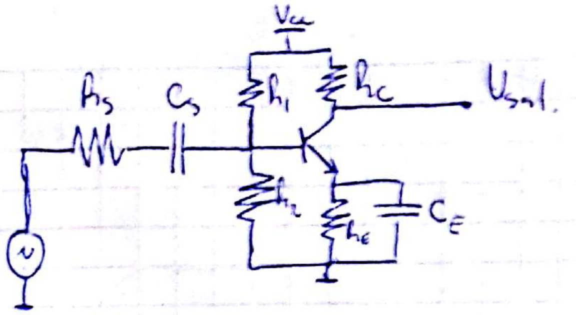
1). 

$U_{cc} = 15V.$

$R_s = 500\Omega$ $\quad R_E = 200\Omega$

$C_s = 10\mu$ $\quad C_E = 10\mu$

$R_1 = 7{,}5K\Omega$ $\quad f_T = 250\ MHz.$

$R_2 = 2{,}2K\Omega$ $\quad C_{bc} = 2{,}5pF.$

$h_{fe} = 100$

$r_{b'b} = 30\Omega$

1) Calcular f_{h_1} para $R_c (R_L) = 100\Omega.$

2) Calcular A_{vm} para $R_c (R_L) = 100\Omega.$

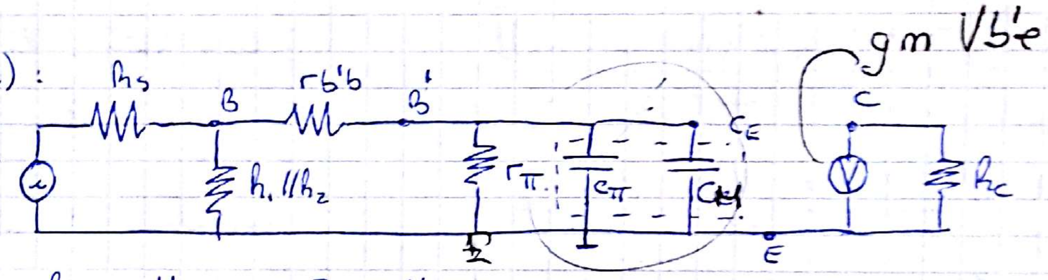
3) Calcular f_{h_2} para $R_c (R_L) = 200\Omega.$

4) Calcular A_{vm} para $R_c (R_L) = 200\Omega$

5) Calcular f_L consirando como polo dominante al Cap de Emisor.

6) Calcular f_L considerando como polo dominante al Cap de base

1) y 2):



$V_B = \frac{R_2}{R_1 + R_2} U_{cc} = 3{,}97\ V.$

$V_E = V_B - 0{,}7\ V = 3{,}27 V.$

$I_E = \frac{V_E}{R_E} = 16{,}35\ mA.$

$r'_e = \frac{25\ mV.}{I_E} = 1{,}52\ \Omega.$

$C_M = C_{b'c} (1 + gm . RL')$

$RL' = Rc // RL$

$C_T = C_\pi + C_M$

$C_{bc} (1 + 40 I_{EQ} . R_c)$

$R_{ent}(tot) = R_s // R_1 // R_2 // \beta_{ca} . r'_e = 110{,}1\Omega.$

$A_{v_m} = \frac{R_{c(alt)}}{r'_e} = \frac{R_c}{r'_e} = 66.$

$C_{M_1} = (A_{v_m} + 1) . C_{bc} = 167{,}5\ pF.$

$\omega_T = 2\pi . f_T = 4{,}7 . 10^9\ rps.$

$C_{be} = C_\pi = \frac{g_m}{\omega_T} = \frac{40 . I_{EQ}}{\omega_T} = 138{,}8\ pF.$

$C_e = C_{be} + C_1 = 306{,}3\ pF.$

$f_h = \frac{1}{2\pi . R_{ent(tot)} . C_e} = 4{,}72\ MHz.$

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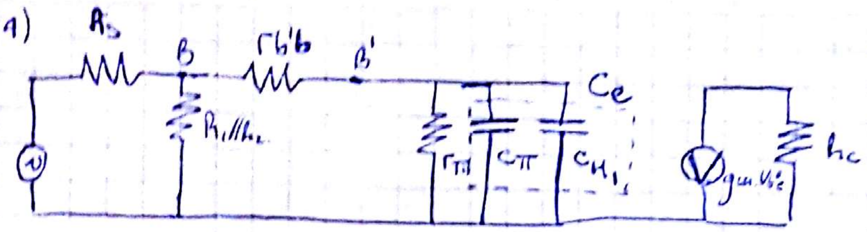
3) y 4)



$V_B = \frac{R_2}{R_1+R_2} \cdot V_{cc} = 3,97 V.$

$V_E = V_B - 0,7 = 3,27 V.$

$I_e = \frac{V_E}{R_E} = \frac{3,27V}{200} = 16,35 mA.$

$r'_e = \frac{25mV}{I_e} = \frac{25mV}{16,35m} = 1,53 \Omega.$

$R_{ent(tot)} = R_s // R_1 // R_2 // r'_e \cdot h_{fe}.$

$= 300 // 7,5k // 2,7k // 1,53 \cdot 100.$

$= 110,62.$

$A_{v\,med} = \frac{R_c(all)}{r'_e} = \frac{R_c}{r'_e} = \frac{200}{1,53} = 130,72.$

$C_{ent(mill)} = (A_{vm}+1) \cdot C_{bc} =$

$= (130,72+1) \cdot 2,5pF = 329,3 pF.$

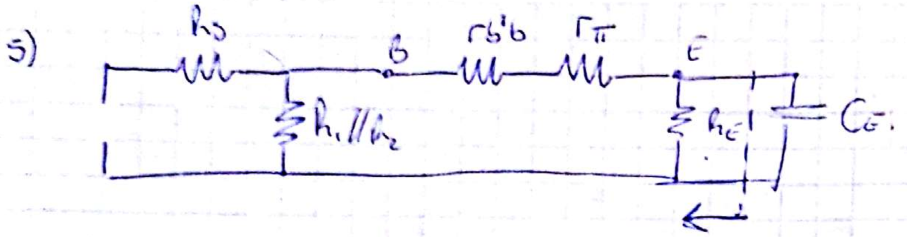
$C_{ent(tot)} = C_{ent(mill)} + \underbrace{C_{be}} = 329,3 pF + 138,8 pF = 468,1 pF$

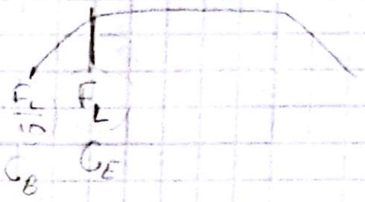
$C_{be} = C_\pi = \frac{g_m}{\underbrace{\omega_T}} = \frac{40 \cdot I_E}{\omega_T} = \frac{40 \cdot 16,35mA}{4,7 \, 10^9} = 138,8 pF$

$\omega_T = 2\pi \cdot F_T = 2\pi \cdot 750 MHz = 4,7 \, 10^9 rps$

$f_{h2} = \frac{1}{2\pi \cdot C_{ent(tot)} \cdot R_{ent(tot)}} = 3,07 MHz.$

5)





$$F_{L_1} = \frac{1}{2\pi C_E \cdot R_{Tot}} =$$

$$R_{Tot} = R_E // \left(\frac{r_\pi + r_{b'b} + (R_1 // R_2 // R_S)}{h_{fe}+1}\right)$$

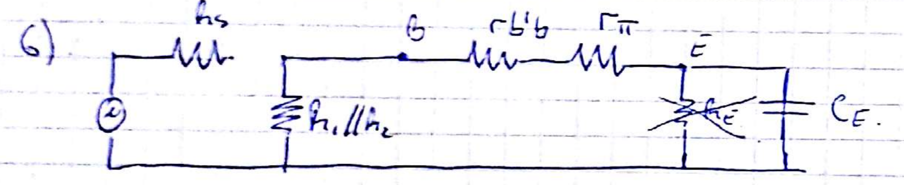
$$= 200 // \left[\left(152 + 30 + (7{,}5k // 2{,}7k // 500)\right)\right] \cdot \frac{1}{h_{fe}+1}$$

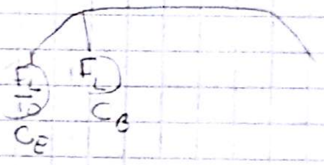
$= 5{,}6\ \Omega$. 5,6. (sin Re reflejado)

$$f_{L_1} = \frac{1}{2\pi 10\mu \cdot} = 2{,}8k\ Hz.$$

(2, 8k).

6)





$$R_{ent(tot)} = R_S + R_1 // R_2 // (r_{b'b} + r_\pi)$$

$$= 500 + (7{,}5k // 2{,}7k) // (30 + 152)$$

$$= 666{,}72$$

$$f_{L_2} = \frac{1}{2\pi \cdot R_{ent} \cdot C_b} = \frac{1}{2\pi \cdot 666{,}72 \cdot 10\mu} = 23{,}87\ Hz.$$

:)

Ej 3.

Altas frec.

①

$$W_h = \frac{1}{\tau_h} = \frac{2{,}2}{t_c} \quad ; \quad t_c = t_2 - t_1$$

Con $t_1 = 0{,}3\ \mu s$; $t_2 = 1\ \mu s$

$$t_c = 1\mu s - 0{,}3\ \mu s = 0{,}7\ \mu s$$

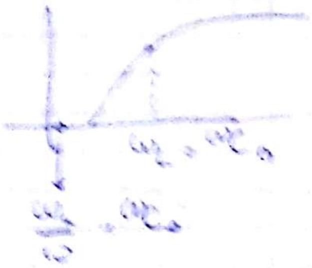
$$W_h = \frac{2{,}2}{0{,}7\mu s} = 3{,}14 \cdot 10^6\ rps$$

$$f_h = \frac{1}{2\pi \cdot R_{ent(tot)} \cdot C_\pi} = 4{,}22\ MHz.$$

3 $\omega_c = \dfrac{1}{\tau_c} = \dfrac{1}{10\,\tau_1} = 333\ 10^3$ cps

$\frac{\omega_1}{\omega} = \omega_{Lp} = \frac{1}{R_{eq_1} \cdot C_b}$ ∴ $R_{eq_1} = R_s + R_{b_1} \parallel (r_{b'b} + r_{b'e} + R_e(h_{fe}+1))$

(b)



$\omega_L = \frac{1}{R_{eq} \cdot C_b}$ ∴ $R_{eq} = R_s + R_{b_1} \parallel (r_{b'b} + r_{b'e})$

Re no aparece porque C_e al estar [illegible] antes queda como corto circuito. (paralelo a Re)

$\omega_{Le} = \frac{\omega_1}{\omega} = \frac{1}{R_{eq_2} \cdot C_e}$ ∴ $R_{eq_2} = R_e \parallel \frac{(r_{b'b} + r_{b'e} + R_{b_1})}{h_{fe}+1}$

Rs no aparece porque Cb está abierto