# Problemă oscilator set 1 sria 1 - 2020

1). $R_2 I_{R_2} - V_{EB1} = 0 \Rightarrow I_{R_2} = \frac{V_{EB1}}{R_2} = \frac{0,6}{150} = 4mA \simeq I_{C_2}$ ($I_{B1}$ negl.)

$-V_{CC} + R_1 I_{R_1} + V_Z = 0 \Rightarrow I_{R_1} = \frac{V_{CC} - V_Z}{R_1} = \frac{10 - 5,6}{1} = 4,4 \, mA = I_Z$

$I_{Z\,min}$

$I_{C_2} = I_{D_3} = 4mA = I_{C5}$

$V_{GS4} = 0 \Rightarrow I_{D_4} = I_{DSS} = 16mA = I_{C1}$

2) Dem. că circ. e un osc. armonic.

Condiții osc. armonic:

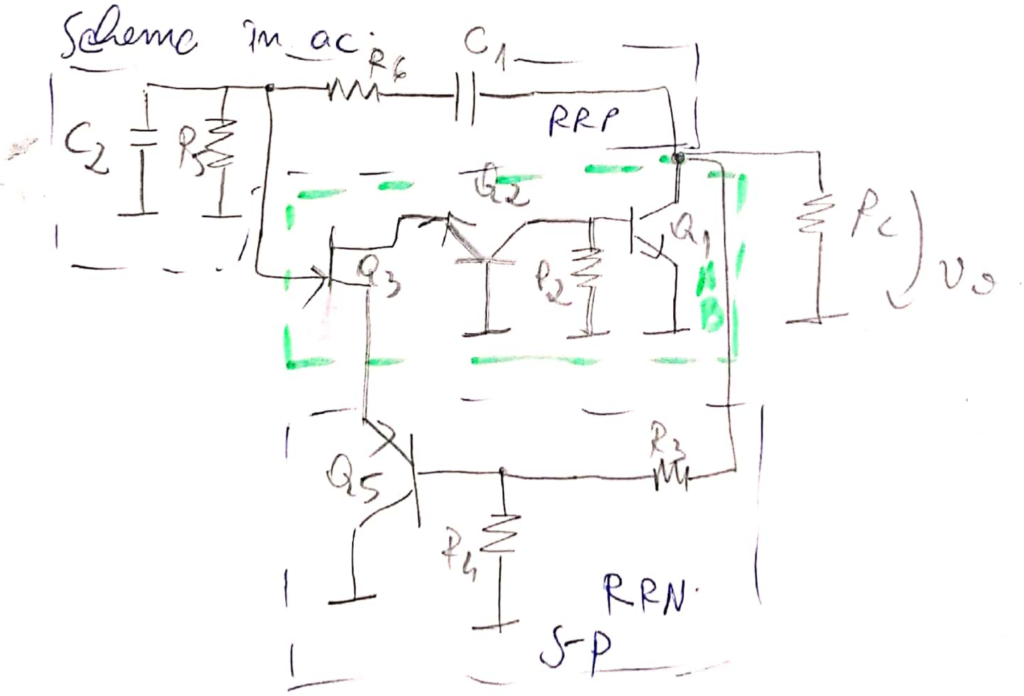
$A_V \cdot \beta_V(\omega_0) = 1$

$\varphi_A + \varphi_B = 0$ sau $2\pi$

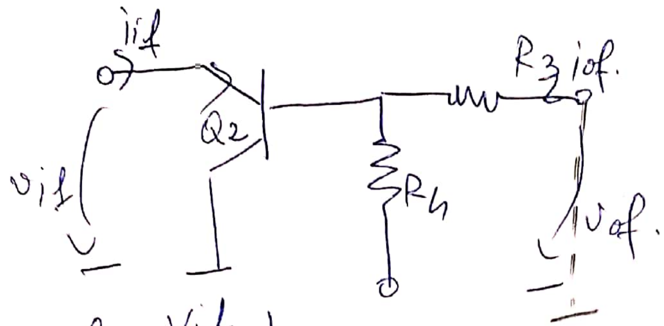
$R_o << |Z_{if}(\omega_0)|$

$R_i >> |Z_{of}(\omega_0)|$

Schema în ac



Analizez RRN




$$h_v = \frac{v_{if}}{v_{of}}\Big|_{i_{if}=0}$$

$$\left.\begin{array}{l} i_{if}=0 \Rightarrow i_{c2}=0 \Rightarrow v_{if} = R_4 i_{of} \\ v_{of}=(R_3+R_4)\, i_{of} \end{array}\right\} \Rightarrow h_v = \frac{v_{if}}{v_{of}} = \frac{R_4 \cancel{i_{of}}}{(R_3+R_4)\cancel{i_{of}}}$$

$$= \frac{1{,}7\,\cancel{k\Omega}}{(1{,}7+3{,}4)\,k\Omega} = \frac{1{,}7}{5{,}1} = \frac{1}{3}$$

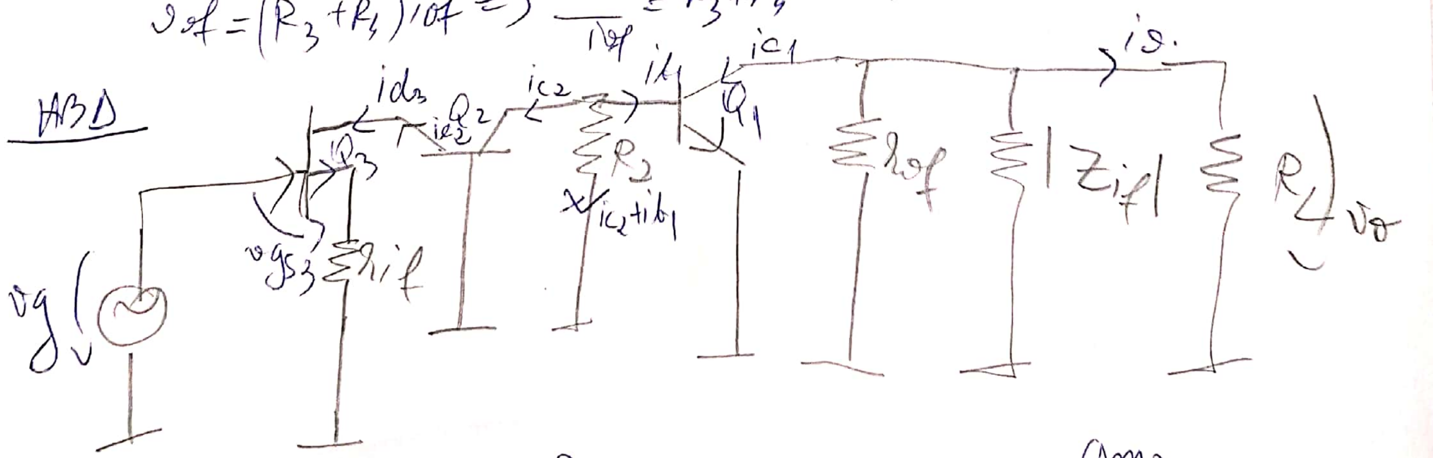
$$r_{if} = \frac{v_{if}}{i_{if}}\Big|_{v_{of}=0}$$

$$\left.v_{if} = i_{if}\cdot R_{ech} = i_{if}\cdot\frac{r_{be2}}{\beta_0+1}\right\} \Rightarrow r_{if} = \frac{r_{be2}}{\beta_0+1} = \frac{\beta_0\cdot\frac{1}{40 I_{C2}}}{\beta_0+1} = \frac{300\cdot\frac{1}{40\cdot 4\cdot 10^{-3}}}{301} = 6{,}22\,\Omega$$

$$r_{of} = \frac{v_{of}}{i_{of}}\Big|_{i_{if}=0}$$

$$v_{of}=(R_3+R_4)\,i_{of} \Rightarrow \frac{v_{of}}{i_{of}} = R_3+R_4 = 5{,}1\,k\Omega$$

ABD




$$a_{vg} = \frac{v_o}{v_g} = \frac{v_o}{\cancel{i_o}}\cdot\frac{\cancel{i_o}}{i_{c1}}\cdot\overset{\beta}{\frac{i_{c1}}{i_{b1}}}\cdot\frac{i_{b1}}{i_{c2}}\cdot\underset{1}{\frac{i_{c2}}{i_{e2}}}\cdot\underset{1}{\frac{i_{e2}}{i_{d3}}}\cdot\overset{g_{m3}}{\frac{i_{d3}}{v_{gs3}}}\cdot\frac{v_{gs3}}{v_g}$$

$$\frac{v_o}{i_{c1}} = -r_{of}\|Z_{if}\|R_L$$

$$-(i_{c2}+i_{b1})R_2 + i_{b1}\cdot r_{be1} = 0 \Rightarrow i_{b1} r_{be1} = i_{c2}R_2 + i_{b1}R_2$$

$$\Rightarrow i_{b1}(r_{be}-R_2) = i_{c2}R_2 \Rightarrow \frac{i_{b1}}{i_{c2}} = \frac{r_{be1}-R_2}{R_2}$$

$$= \frac{r_{be1}}{R_2} - 1 = \frac{\beta_0 \cdot \frac{1}{40 I_{C1}}}{R_1} - 1 = \frac{300\cdot\frac{1}{40\cdot 16\cdot 1}}{1} - 1 \cong -0,5$$

$$-v_g + v_{gs3} + i_{d3} r_{if} = 0 \Leftrightarrow -v_g + v_{gs3} + g_{m3} v_{gs3} r_{if} = 0 \Rightarrow$$

$$\Rightarrow v_g = v_{gs3}(1 + g_{m3} r_{if}) \Rightarrow \frac{v_{gs3}}{v_g} = \frac{1}{1+g_{m3} r_{if}}$$

$$a_{vg} = -(r_{of} \| Z_{if} \| R_L)\cdot(-0,5)\cdot 300\cdot 1\cdot 1\cdot \underbrace{g_{m3}\cdot\frac{1}{1+g_{m3} r_{if}}}_{0,16}$$

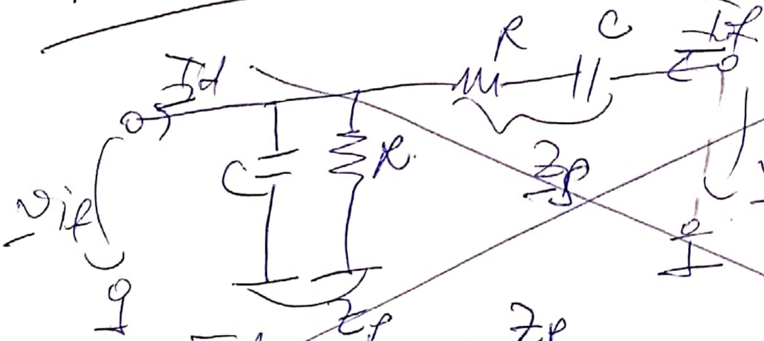
$$r_i = \frac{v_i}{i_i} = \infty \qquad 0 = i_{g3}$$

$$r_o = R_2 \| r_{of} \| Z_{if}$$

$$\cancel{g_{m3} = \frac{2 I_{DSS}}{|V_T|}\left(1 - \frac{V_{GS3}}{V_T}\right) = \frac{2\cdot 16}{2}\left(1-\frac{V_{GS3}}{V_T}\right)}$$

$$g_{m3} = \sqrt{\frac{4 I_{DSS}}{|V_T|^2} I_{D3}} = \sqrt{\frac{4\cdot 16}{4}\cdot 4} = 2\cdot 4 = 8\ mA/V$$

Analiza ARP - Wien trans de tensiune!



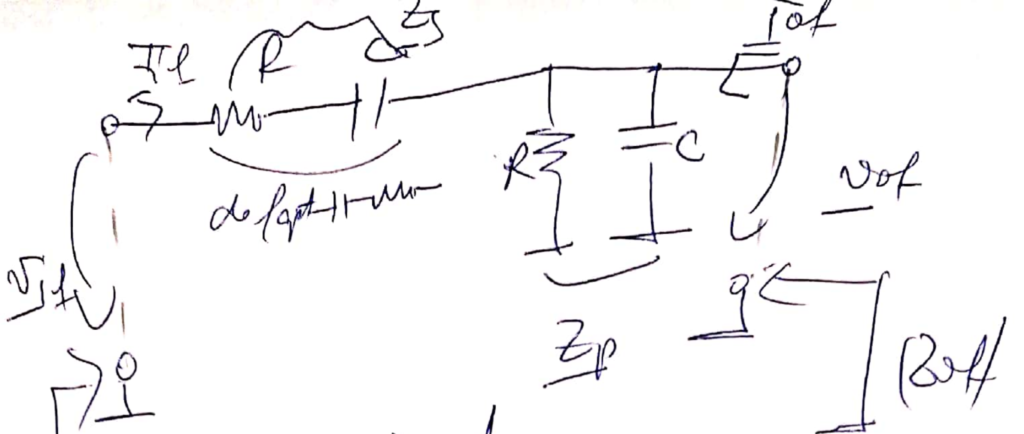
$$I_{of} Z_s + Z_p(I_{of}+I_{if}) = 0$$

$$\Rightarrow I_{of}(Z_s+Z_p) + Z_p I_{if} = 0$$

$$\frac{I_{of}}{I_{if}} = \frac{-Z_p}{Z_s+Z_p}$$

$$\beta_I = \frac{I_{of}}{I_{if}}\Big|_{v_{of}=0} = \frac{-Z_p}{Z_s+Z_p}$$

Scanned with CamScanner




$\beta_v(\omega_0) = \frac{1}{3}$

$Z_{if}$

$$\cancel{Z_{if} = \frac{v_{if}}{I_{if}}\Big|_{v_{of}=0}}$$

$$\cancel{-v_{if} + I_{if} Z_s + (I_{of} + I_{if}) Z_p = 0}$$

$$\cancel{\Rightarrow v_{if} = I_{if} Z_s \Rightarrow \frac{v_{if}}{I_{if}} = Z_s}$$

$$Z_{of} = \frac{v_{of}}{I_{of}}\Big|_{v_{if}=0} =$$

$$v_{of} = Z_p I_{of} \Rightarrow \frac{v_{of}}{I_{of}} = Z_p$$

$$Z_{if} = \frac{v_{if}}{I_{if}}\Big|_{I_{of}=0} = Z_s + Z_p.$$

$$|Z_{if}(\omega_0)| = \frac{3}{\sqrt{2}} R = \frac{3}{\sqrt{2}} \cdot 10 = 21{,}21\ k\Omega$$

$$|Z_{of}(\omega_0)| = \frac{\sqrt{2}}{3} R = 4{,}71\ k\Omega$$

Deci $r_{of} \,\|\, Z_{if} \,\|\, R_L$

$$\frac{1}{R_e} = \frac{1}{r_{of}} + \frac{1}{Z_{if}} + \frac{1}{R_L} = \frac{1}{5{,}1} + \frac{1}{21{,}21} + \frac{1}{10} = 0{,}34322$$

$$\Rightarrow R_e = 2{,}9135\ k\Omega = 2{,}9135 \cdot 10^3\ \Omega$$

$$a_{vg} = (-2{,}9135 \cdot 10^3) \cdot (-0{,}5) \cdot 300 \cdot 0{,}16 = 69{,}925 \cdot 10^3 \Rightarrow$$

$$\boxed{A_{vg} \cong \frac{1}{f_V} = 3.}$$

$$T = a_{vg} \cdot f_V = 69925 \cdot \frac{1}{3} = 23308$$

$$R_i = (1+T) r_i = \infty$$

$$R_o^{-1} = (1+T) r_o^{-1} - |Z_{if}(w_0)|^{-1}$$

$$R_o^{-1} = \frac{23309}{\cancel{5,1}} - \frac{1}{21,21} = 4570,392 - 0,047 = 4570,344 \; k\Omega^{-1}$$

$$\Rightarrow R_o = \frac{1}{4570,344} = 0,000218 \; k\Omega = 0,218 \; \Omega$$

Așadar $A_{vg} \cdot \beta_V(w_0) = 3 \cdot \frac{1}{3} = 1$ (A)

$\phi_A = 0°$; $\phi_B = 0° \Rightarrow \phi_A° + \phi_B° = 0$ (A) (transfer)

$R_o = 0,218 \, \Omega << |Z_{if}(w_0)| = 21,21 \, k\Omega$ (A)

$R_i = \infty >> |Z_{of}(w_0)| = 4,71 \, k\Omega$ (A)

$\Rightarrow$ osc. armonic

3) $A_{vg} = \frac{1}{f_V} = \frac{R_3 + R_4}{R_4} = \frac{R_3}{R_4} + 1$

$A_{vg} \cdot \beta_V(w_0) = 1$ în regim permanent $\Rightarrow A_{vg} = \frac{1}{\beta_V} = 3$

$A_{vg} \cdot \beta_V(w_0) > 1$ pt amorsare $\Rightarrow A_{vg} > \frac{1}{\beta_V(w_0)} = \frac{1}{\frac{1}{3}} = 3$

$A_{vg} \cdot \beta_V(w_0) < 1$ pt stabilizare. $\Rightarrow A_{vg} < 3$

$$1 + \frac{R_3}{R_4} > 3 \Rightarrow \frac{R_3}{R_4} > 2 \Rightarrow R_3 > 2R_4 \Rightarrow R_4 < \frac{R_3}{2} = 1,7.$$

$\Rightarrow$ la $t=0$ $R_4$ ia o valoare $< 1{,}7\ k\Omega$ după care, pe-măsură ce apar osc, $R_4$ trb să ajungă la $1{,}7\ k\Omega \Rightarrow$ termistor PTC

4) $f_0 = \frac{1}{2\pi RC} = \frac{1}{2\pi \cdot 10 \cdot 10^3 \cdot 30 \cdot 10^{-9}} = \frac{10^4}{2\pi \cdot 3} =$

$= 530\ Hz = 0{,}530\ kHz.$