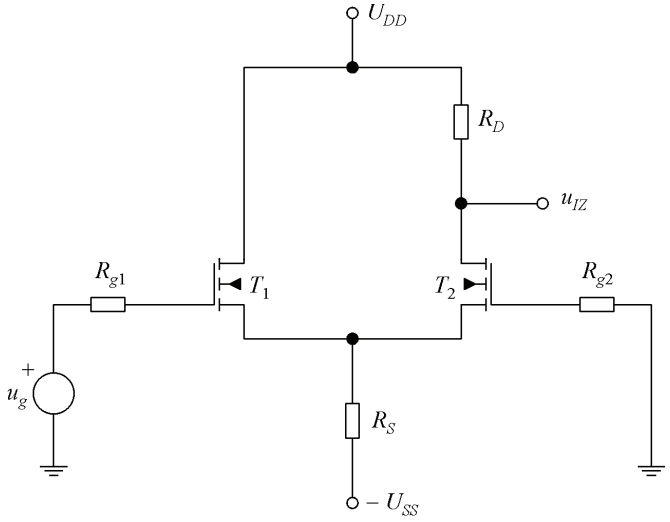
Međuispit iz "Elektronike 2" - rješenja

Zadaci

1. zadatak



$$I_{DQ1} = \frac{U_{SS} - U_{GSQ1}}{2\,R_S} = \frac{K}{2}\left(U_{GSQ1} - U_{GS0}\right)^2,$$

$$9 \cdot U_{GSQ1}^2 - 35 \cdot U_{GSQ1} + 24 = 0 \quad \rightarrow \quad U_{GSQ1} = 3\ \text{V} = U_{GSQ2},$$

$$I_{DQ1} = \ I_{DQ2} = \frac{U_{SS} - U_{GSQ1}}{2\,R_S} = 1{,}5\ \text{mA},$$

$$U_{DSQ1} = U_{DD} + U_{SS} - 2\,R_S\,I_{DQ1} = 15\ \text{V}, \quad U_{DSQ2} = U_{DD} + U_{SS} - \left(R_D + 2R_S\right) I_{DQ2} = 12\ \text{V},$$

$$g_{m2} = K\left(U_{GSQ2} - U_{GS0}\right)\left(1 + \lambda\,U_{DSQ2}\right) = 3{,}04\ \text{mA/V},$$

$$r_{d2} = \frac{1}{\lambda\,I_{DQ2}} = 667\ \text{k}\Omega, \ \ \mu_2 = g_{m2}\,r_{d2} = 2028,$$

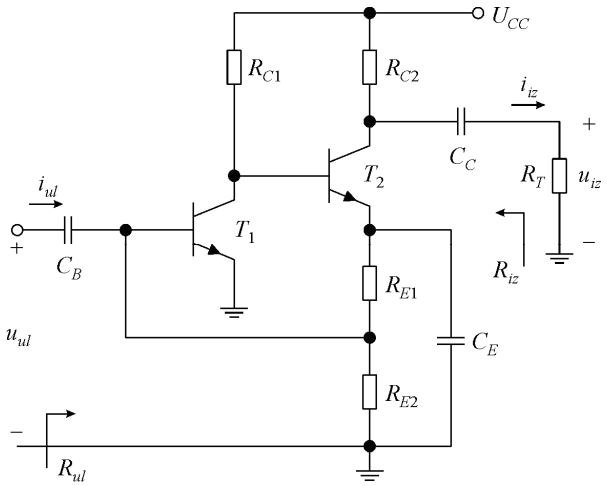
$$A_{Vz} = \frac{u_{iz}}{u_z} = \frac{-\,\mu_2\,R_D}{2\left(1 + \mu_2\right)R_S + r_{d2} + R_D} = -\,0{,}316, \ A_{Vd} = \frac{u_{iz}}{u_d} = \frac{-\,\mu_2\,R_D}{2\left(r_{d2} + R_D\right)} = -\,3{,}03,$$

$$\rho = \frac{\left|A_{Vd}\right|}{\left|A_{Vz}\right|} = 9{,}59,$$

$$U_{zm} = \frac{U_{gm} + 0}{2} = \frac{U_{gm}}{2} = 100\ \text{mV}, \ \ U_{dm} = 0 - U_{gm} = -\,U_{gm} = -\,200\ \text{mV},$$

$$U_{izm} = A_{Vz}\,U_{zm} + A_{Vd}\,U_{dm} = 574\ \text{mV}, \ \ u_{iz} = 574 \sin \omega t\ \text{mV}.$$

2. zadatak

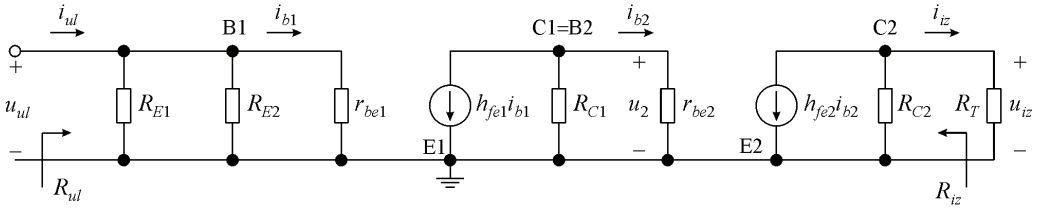


$$I_{CQ2} \approx \frac{U_{BEQ1}}{R_{E2}} = 1{,}4 \text{ mA},$$

$$U_{CC} \approx I_{CQ1} R_{C1} + U_{BEQ2} + I_{CQ2}\left(R_{E1} + R_{E2}\right) \quad \rightarrow \quad I_{CQ1} = 1{,}6 \text{ mA},$$

$$U_{CEQ1} \approx U_{CC} - I_{CQ1} R_{C1} = 7 \text{ V}, \quad U_{CEQ2} \approx U_{CC} - I_{CQ2}\left(R_{C2} + R_{E1} + R_{E2}\right) = 3{,}1 \text{ V},$$

$$r_{be1} = \frac{U_T}{I_{BQ1}} = \frac{\beta U_T}{I_{CQ1}} = 1{,}56 \text{ k}\Omega, \quad r_{be2} = \frac{U_T}{I_{BQ2}} = \frac{\beta U_T}{I_{CQ2}} = 1{,}79 \text{ k}\Omega,$$



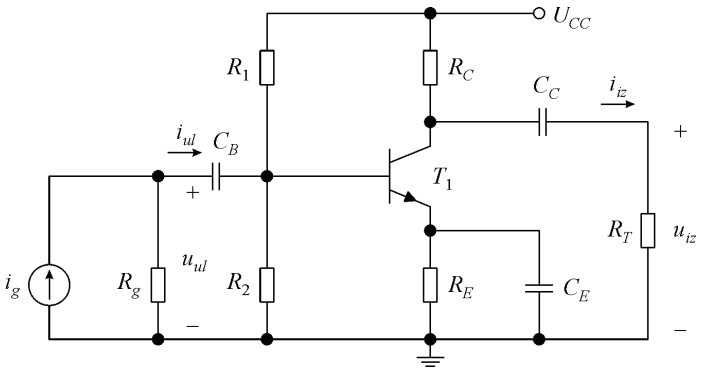
$$A_{V2} = \frac{u_{iz}}{u_2} = -h_{fe} \frac{R_{C2} \| R_T}{r_{be2}} = -74{,}5, \quad A_{V1} = \frac{u_2}{u_{ul}} = -h_{fe} \frac{R_{C1} \| r_{be2}}{r_{be1}} = -84{,}5,$$

$$A_V = \frac{u_{iz}}{u_{ul}} = A_{V2} A_{V1} = 6300,$$

$$R_{ul} = \frac{u_{ul}}{i_{ul}} = R_{E1} \| R_{E2} \| r_{be1} = 346 \ \Omega, \quad A_I = \frac{i_{iz}}{i_{ul}} = \frac{u_{iz} / R_T}{u_{ul} / R_{ul}} = A_V \frac{R_{ul}}{R_T} = 1090,$$

$$R_{iz} = R_{C2} = 4 \text{ k}\Omega.$$

3. zadatak

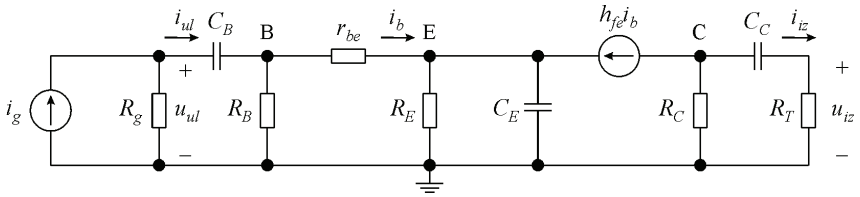


$$U_{BB} = \frac{R_2}{R_1 + R_2} U_{CC} = 1{,}36 \text{ V} \,,\; R_B = R_1 \,\|\, R_2 = 18{,}2 \text{ k}\Omega \,,$$

$$I_{BQ} = \frac{U_{BB} - U_{BEQ}}{R_B + (1+\beta) R_E} = 3 \text{ μA} \,,\; I_{CQ} = \beta I_{BQ} = 0{,}3 \text{ mA} \,,$$

$$U_{CEQ} \approx U_{CC} - (R_C + R_E) I_{CQ} = 11{,}7 \text{ V} \,,$$

$$r_{be} = \frac{U_T}{I_{BQ}} = 8{,}33 \text{ k}\Omega \,,$$



$$A_{Ig0} = \frac{I_{iz}}{I_g} = \frac{I_{iz}}{I_b} \frac{I_b}{I_g} = -\, h_{fe} \frac{R_C}{R_C + R_T} \frac{R_g \,\|\, R_B}{R_g \,\|\, R_B + r_{be}} = -\, 55{,}4 \,,$$

$$\tau_B = (R_g + R_B \,\|\, r_{be}) C_B = 167 \text{ ms} \,,\; \omega_B = \frac{1}{\tau_B} = 5{,}99 \text{ rad/s} \,,$$

$$\tau_E = \left(\frac{r_{be} + R_g \,\|\, R_B}{1 + h_{fe}} \,\middle\|\, R_E \right) C_E = 9{,}69 \text{ ms} \,,\; \omega_E = \frac{1}{\tau_E} = 103 \text{ rad/s} \,,$$

$$\tau_C = (R_C + R_T) C_C = 150 \text{ ms} \,,\; \omega_C = \frac{1}{\tau_C} = 6{,}67 \text{ rad/s} \,,$$

$$\omega_d = \omega_E = 103 \text{ rad/s} \,,\; f_d = \frac{\omega_d}{2\pi} = 16{,}4 \text{ Hz} \,.$$