

Pisni izpit xxxxxx

Ime in priimek: _____

Vpisna številka: _____

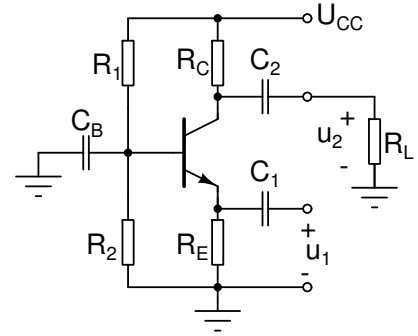
Naloga 1

Določite napetostno ojačenje za srednje frekvence. Podani so admitančni parametri tranzistorja za orientacijo s skupnim emitorjem:

$$Y_E = \begin{bmatrix} 0.34\text{mS} & 0 \\ 33.7\text{mS} & 17.9\mu\text{S} \end{bmatrix}$$

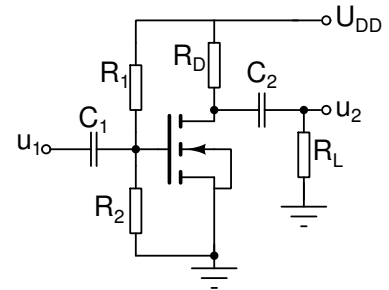
$$R_E = 0.5\text{k}\Omega, R_C = 1.2\text{k}\Omega, R_1 = 6.9\text{k}\Omega, R_2 = 2.1\text{k}\Omega,$$

$$U_{CC} = 5\text{V}, \beta_F = 100, V_{AF} = 50\text{V}, R_L = 5\text{k}\Omega$$

**Naloga 2**

Določite vrednosti elementov, da bo v delovni točki $I_D = 2\text{mA}$, $U_{DS} = 4\text{V}$. Vhodna upornost pri srednjih frekvencah naj bo $R_{vh} = 50\text{k}\Omega$.

$$U_{DD} = 10\text{V}, K = 4\text{mA/V}^2, U_T = 1\text{V}, \lambda = 0, R_L = 5\text{k}\Omega$$

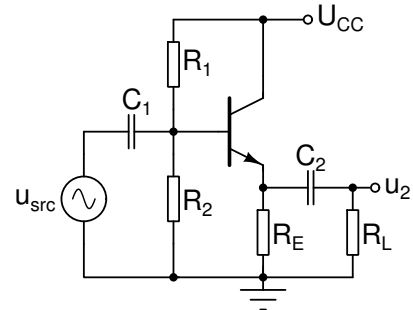
**Naloga 3**

Določite delovno točko tranzistorja (I_C, U_{CE}).

$$U_{CC} = 10\text{V}, \beta_F = 150, V_{AF} = 100\text{V},$$

$$R_1 = 30\text{k}\Omega, R_2 = 70\text{k}\Omega, R_E = 5\text{k}\Omega, R_L = 1\text{k}\Omega$$

$$C_2 = 4.7\mu\text{F}, C_1 = 10\mu\text{F}$$

**Naloga 4**

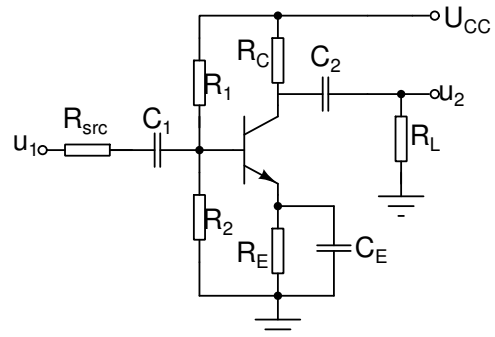
Določite spodnjo frekvenčno mejo vezja. Podani so admitančni parametri tranzistorja za orientacijo s skupnim emitorjem:

$$Y_E = \begin{bmatrix} 0.25\text{mS} & 0 \\ 37\text{mS} & 9.8\mu\text{S} \end{bmatrix}$$

$$U_{CC} = 10\text{V}, R_E = 1\text{k}\Omega, R_C = 5\text{k}\Omega, R_1 = 8.3\text{k}\Omega,$$

$$R_2 = 1.7\text{k}\Omega, R_L = 1\text{k}\Omega, R_{src} = 100\Omega,$$

$$C_2 = 4.7\mu\text{F}, C_1, C_E \rightarrow \infty$$



Admitančni parametri:

$$\begin{aligned}
 i_1 &= y_{11}u_1 + y_{12}u_2 \\
 i_2 &= y_{21}u_1 + y_{22}u_2 \\
 y_{11} &= \frac{1}{h_{11}}, \quad y_{12} = -\frac{h_{12}}{h_{11}} \\
 y_{21} &= \frac{h_{21}}{h_{11}}, \quad y_{22} = \frac{D_h}{h_{11}}
 \end{aligned}$$

$$A_u = -\frac{y_{21}}{y_{22} + Y_L}, \quad A_i = \frac{y_{21}}{y_{11} + Z_L D_y}, \quad Y_{in} = y_{11} - \frac{y_{12}y_{21}}{y_{22} + Y_L}, \quad Y_{out} = y_{22} - \frac{y_{12}y_{21}}{y_{11} + Y_{src}}$$

Hibridni parametri:

$$\begin{aligned}
 u_1 &= h_{11}i_1 + h_{12}u_2 \\
 i_2 &= h_{21}i_1 + h_{22}u_2 \\
 h_{11} &= \frac{1}{y_{11}}, \quad h_{12} = -\frac{y_{12}}{y_{11}} \\
 h_{21} &= \frac{y_{21}}{y_{11}}, \quad h_{22} = \frac{D_y}{y_{11}}
 \end{aligned}$$

NMOS (skupni izvor):

za $u_{GS} > U_T, u_{DS} > u_{GS} - U_T$:

$$\begin{aligned}
 i_D &= \frac{1}{2}K(u_{GS} - U_T)^2(1 + \lambda u_{DS}) \\
 g_{21} &= \frac{2I_D}{U_{GS} - U_T}, \quad g_{22} = \frac{\lambda I_D}{1 + \lambda U_{DS}}
 \end{aligned}$$

PMOS (skupni izvor):

za $-u_{GS} > U_T, -u_{DS} > -u_{GS} - U_T$:

$$\begin{aligned}
 -i_D &= \frac{1}{2}K(u_{GS} + U_T)^2(1 - \lambda u_{DS}) \\
 g_{21} &= \frac{2I_D}{U_{GS} + U_T}, \quad g_{22} = \frac{\lambda I_D}{1 - \lambda U_{DS}}
 \end{aligned}$$

NPN (skupni emitor):

v aktivnem področju:

$$\begin{aligned}
 g_{11} &= \frac{I_B}{V_T}, \quad g_{21} = \frac{I_C}{V_T}, \\
 g_{22} &= \frac{I_C}{U_{CE} + V_{AF}} \\
 \frac{g_{21}}{g_{11}} &= \beta = \beta_F(1 + \frac{U_{CE}}{V_{AF}})
 \end{aligned}$$

PNP (skupni emitor):

v aktivnem področju:

$$\begin{aligned}
 g_{11} &= -\frac{I_B}{V_T}, \quad g_{21} = -\frac{I_C}{V_T}, \\
 g_{22} &= \frac{-I_C}{-U_{CE} + V_{AF}} \\
 \frac{g_{21}}{g_{11}} &= \beta = \beta_F(1 + \frac{-U_{CE}}{V_{AF}})
 \end{aligned}$$

RC člen - mejna frekvenca: $f_{-3dB} = \frac{1}{2\pi\tau} = \frac{1}{2\pi R_{eq}C}$ Miller-jev pojav (preslikava impedance med vhodom in izhodom tranzistorja z napetostnim ojačenjem A_0 na vhod tranzistorja):

$$Z_{M,vhod} = \frac{Z_{vhod-izhod}}{1-A_0} \Rightarrow \text{za skupni emitor: } C_M = (1 - A_0)C_{bc}$$

Kvadratna enačba:

$$\begin{aligned}
 ax^2 + bx + c &= 0 \\
 D &= b^2 - 4ac \\
 x_{i,2} &= \frac{-b \pm \sqrt{D}}{2a}
 \end{aligned}$$