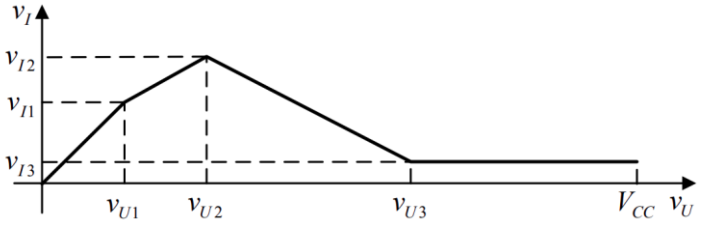
Osnovi analogne elektronike – februar 2023 - rešenja

3. rešenje

Izrazi koji opisuju funkcije prenosa kola:

$$v_I = \begin{cases} v_U & 0\,\text{V} \le v_U \le 0.7\,\text{V} \\ \frac{v_U}{2} + 0.35\,\text{V} & 0.7\,\text{V} \le v_U \le 1.4\,\text{V} \\ -\frac{v_U}{2} + 1.75\,\text{V} & 1.4\,\text{V} \le v_U \le 3.1\,\text{V} \\ 0.2\,\text{V} & 3.1\,\text{V} \le v_U \le 5\,\text{V} \end{cases},$$

Grafički prikaz je dat:



gde je:

$v_{I1} = v_{U1} = 0.7$ V

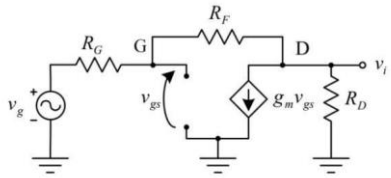
$v_{U2} = 1.4$ V , $v_{I2} = 1.05$ V.

$v_{U3} = 3.1$ V, $v_{I3} = 0.2$ V.

4. rešenje

a) $I_D = 2mA$

b)

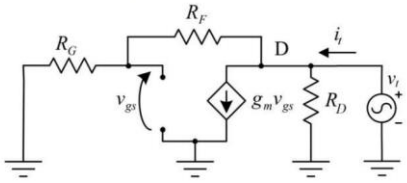


$$A_V = \frac{R_D(1 - g_m R_F)}{R_D + R_F + R_G + g_m R_D R_G} = -3.26$$

c)

$$i_g = \frac{v_g - v_i}{R_G + R_F} = \frac{v_g - A_V v_g}{R_G + R_F}$$

$$R_U = \frac{v_g}{i_g} = \frac{R_G + R_F}{1 - A_V} \approx 14.1k\Omega$$



$$i_t = g_m v_{gs} + \frac{v_t}{R_F + R_G} + \frac{v_t}{R_D}$$

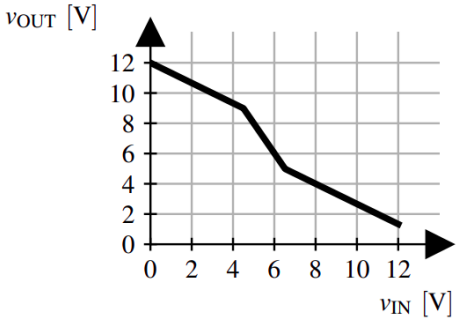
$$v_{gs} = v_t \frac{R_G}{R_G + R_F}$$

$$R_i = \frac{v_t}{i_t} = \frac{1}{\frac{g_m R_G}{R_G + R_F} + \frac{1}{R_F + R_G} + \frac{1}{R_D}} \approx 983\Omega$$

7. rešenje

(a)

$$v_{\mathrm{I}} = \begin{cases} -\frac{2}{3}v_{\mathrm{IN}} + 12\,\mathrm{V} & , \quad 0 \le v_{\mathrm{IN}} \le 4{,}5\,\mathrm{V} \\ -2v_{\mathrm{IN}} + 18\,\mathrm{V} & , \quad 4{,}5\,\mathrm{V} \le v_{\mathrm{IN}} \le 6{,}5\,\mathrm{V} \\ -\frac{2}{3}v_{\mathrm{IN}} + \frac{28}{3}\,\mathrm{V} & , \quad 6{,}5\,\mathrm{V} \le v_{\mathrm{IN}} \le 12\,\mathrm{V} \end{cases}$$



(б) $v_{\mathrm{OUT}} = 7\,\mathrm{V} - 0{,}2\,\mathrm{V}\sin(\omega t)$.

8. rešenje

a) Otpornost R_0 je:

$$R_0 = \frac{V_{\mathrm{CC}} - V_{\mathrm{BE}}}{I_3} = 1.72\ k\Omega$$

b) Transkonduktansa tranzistora u mirnoj radnoj tački iznosi

$$g_{m2} = g_m = \frac{I_{C1/2}}{V_T} = 0.05\ S,$$

te je diferencijalno pojačanje pojačavača

$$A_d = \frac{v_i}{v_d} = \frac{g_m R_C}{2} = 25$$