RJEŠENJA - JESENSKI ISPITNI ROK IZ ELEKTRONIKE 1

ZADATAK 1.

a) $n_{on} = N_D = n_i^2 / p_{0n} = 2.1*10^{17}$ cm^{-3}
$p_{0p} = N_A = n_i^2 / n_{0p} = 2.1*10^{15}$ cm^{-3}

b) $U_K = 733.7$ mV

c) $D_n = U_T*\mu_n = 21.98$ cm^2/s, $D_p = U_T*\mu_p = 7.24$ cm^2/s, $L_n = 30$ μm, $w_n = 2$ μm ,$S = 2$ mm^2
$I_S = 2.46$ pA

d) $U = U_T * ln(n_{p0} / n_{0p}) = 553.8$ mV
$I_D = I_S*(exp(U/mU_T) - 1) = 4.92$ mA

e) $r_d = mU_T / (I + I_S) = 5.25$ Ohm

ZADATAK 2.

a) $U_{GS0} = \frac{U_{GSA} - U_{GSB}\sqrt{\frac{I_{DA}}{I_{DB}}}}{1-\sqrt{\frac{I_{DA}}{I_{DB}}}} = -1\ V$

b) p-kanalni MOSFET obogaćenog tipa

c) $K = \frac{2\,I_{DA}}{(U_{GSA} - U_{GS0})^2} = -1\,\frac{mA}{V^2}$

d) $I_{DC} = K\left[(U_{GSC} - U_{GS0})U_{DSC} - \frac{U_{DSC}^2}{2}\right] = -4\ mA$

$g_{mC} = K\,U_{DSC} = 2\,\frac{mA}{V}$

$g_{dC} = K(U_{GSC} - U_{GS0} - U_{DSC}) = 1\,\frac{mA}{V}$

e) $g_{mB} = K(U_{GSB} - U_{GS0}) = 2\,\frac{mA}{V}$

ZADATAK 3.

a) spoj zajedničkog odvoda

b) $U_{GSQ} = 1{,}5 \pm \sqrt{1{,}5^2 + 4} = 1{,}5 + 2{,}5 = 4$ V $\quad I_{DQ} = \frac{U_{GG} - U_{GSQ}}{R_S} = \frac{8-4}{2} = 2$ mA

$U_{DSQ} = U_{DD} - R_S\,I_{DQ} = 12 - 2\cdot 2 = 8$ V

c) $A_V = \frac{u_{iz}}{u_{ul}} = \frac{g_m\left(r_d \,\|\, R_S \,\|\, R_T\right)}{1 + g_m\left(r_d \,\|\, R_S \,\|\, R_T\right)} = \frac{2{,}08\cdot\left(100\,\|\,2\,\|\,10\right)}{1 + 2{,}08\cdot\left(100\,\|\,2\,\|\,10\right)} = 0{,}766$ ili

$= \frac{2\cdot\left(100\,\|\,2\,\|\,10\right)}{1 + 2\cdot\left(100\,\|\,2\,\|\,10\right)} = 0{,}773$.

d) $R_{ul} = R_G = 1{,}33$ MΩ

ZADATAK 4.

statički radni pravac (1): $U_{CE} = U_{CC} - I_C(R_C + R_E)$

dinamički radni pravac (1): $u_{CE} - U_{CEQ} = -(i_C - I_Q)R_C||R_P$

$$U_{CE,max} = 2{,}992V$$

$$A_V = -h_{fe}\frac{R_C||R_P}{r_{be}} = -119{,}7$$

$$U_{ulmax} = \frac{U_{izmax}}{|A_V|} = 25mV$$

ZADATAK 5.

a)
$$U_+ = \frac{U_{ul1}R_2 + U_{ul2}R_1}{R_1 + R_2}$$

$$U_{iz} = \left(1+\frac{R_3}{R_4}\right)U_+ = \left(1+\frac{R_3}{R_4}\right)\frac{U_{ul1}R_2 + U_{ul2}R_1}{R_1 + R_2}$$

b) $$R_3 = R_4\left(\frac{U_{iz}\left(R_1+R_2\right)}{U_{ul1}R_2 + U_{ul2}R_1} - 1\right) = 2k\left(\frac{6\left(1k+1k\right)}{1\cdot 1k + 3\cdot 1k} - 1\right) = 4k\Omega$$

c) U_{R4}= 2 V i ne ovisi o otporu R_3