1. zadatak

a)

$$R_{PS} = R_n = \frac{1}{K_n'(W/L)_n(U_{GSn} - U_{GS0n})} = 476 \ \Omega .$$

b)

$$R_{PS} = R_p = \frac{1}{K_p'(W/L)_p(U_{GSp} - U_{GS0p})} \quad \rightarrow \quad W_p = \frac{L_p}{K_p' R_{PS}(U_{GSp} - U_{GS0p})} = 2,5 \ \mu m .$$
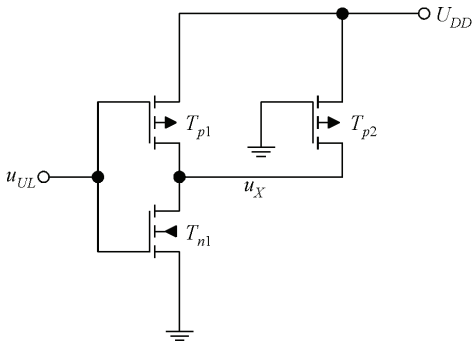
c)

$$R_{PS} = R_n \| R_p ,$$

U_A, V	U_{GSn}, V	U_{GSp}, V	R_n, Ω	R_p, Ω	R_{PS}, kΩ
0,6	1,2	$-0,6$	833	3333	667
0,9	0,9	$-0,9$	1333	1333	667
1,2	0,6	$-1,2$	33331	833	667

2. zadatak

a)

$u_{UL} = u_X = U_{UL+} = 1,1 \ \text{V}$

$u_{GSp1} - U_{GS0p}^0 = U_{UL+} - U_{DD} - U_{GS0p}^0 = -0,3 \ \text{V} \rightarrow$ klasično zasićenje

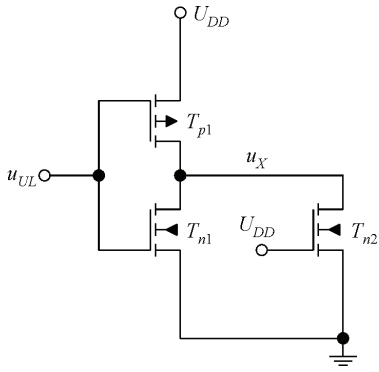$u_{GSp2} - U_{GS0p}^0 = 0 - U_{DD} - U_{GS0p}^0 = -1,4 \ \text{V} \rightarrow$ zasićenje brzine nosilaca

$u_{GSn1} - U_{GS0n}^0 = U_{UL+} - U_{GS0n}^0 = 0,7 \ \text{V} \rightarrow$ zasićenje brzine nosilaca

$$K_n\left(\frac{W}{L}\right)_{n1}\left(U_{UL+} - U_{GS0n}^0 - \frac{U_{DSzasn}}{2}\right)U_{DSzasn} =$$

$$= -\frac{K_p}{2}\left(\frac{W}{L}\right)_{p1}\left(U_{UL+} - U_{DD} - U_{GS0p}^0\right)^2 - K_p\left(\frac{W}{L}\right)_{p2}\left(-U_{DD} - U_{GS0p}^0 - \frac{U_{DSzasp}}{2}\right)U_{DSzasp}$$

$$\left(\frac{W}{L}\right)_{p2} = 2,59$$

b)

1

$$u_{UL} = u_X = U_{UL-} = 0,7 \text{ V}$$

$$u_{GSn1} - U_{GS0n}^0 = U_{UL-} - U_{GS0n}^0 = 0,3 \text{ V} \rightarrow \text{klasično zasićenje}$$

$$u_{GSn2} - U_{GS0n}^0 = U_{DD} - U_{GS0n}^0 = 1,4 \text{ V} \rightarrow \text{zasićenje brzine nosilaca}$$

$$u_{GSp1} - U_{GS0p}^0 = U_{UL+} - U_{DD} - U_{GS0p}^0 = -0,7 \text{ V} \rightarrow \text{zasićenje brzine nosilaca}$$

$$\frac{K_n}{2}\left(\frac{W}{L}\right)_{n1}\left(U_{UL-} - U_{GS0n}^0\right)^2 + K_n\left(\frac{W}{L}\right)_{n2}\left(U_{DD} - U_{GS0n}^0 - \frac{U_{DSzasn}}{2}\right)U_{DSzasn} =$$

$$= -K_p\left(\frac{W}{L}\right)_{p1}\left(U_{UL-} - U_{DD} - U_{GS0p}^0 - \frac{U_{DSzasp}}{2}\right)U_{DSzasp}$$

$$\left(\frac{W}{L}\right)_{n2} = 1,69$$

3. zadatak

a)

$$K_n'\frac{W_1}{L_1}\left(U_{PO} - U_{GS0n}^0 - \frac{U_{DSzasn}}{2}\right)U_{DSzasn} = -K_p\frac{W_2}{L_2}\left(U_{PO} - U_{DD} - U_{GS0p}^0 - \frac{U_{DSzasp}}{2}\right)U_{DSzasp}$$

$$r = \frac{(W/L)_2}{(W/L)_1}\frac{K_p'}{K_n'}\frac{U_{DSsp}}{U_{DSsn}} = 0,8 \quad \rightarrow \quad U_{PO} = \frac{\left(U_{GS0n}^0 + \frac{U_{DSzasn}}{2}\right) + r\left(U_{DD} + U_{GS0p}^0 + \frac{U_{DSzasp}}{2}\right)}{1 + r} = 0,85 \text{ V}$$

b) U $t = 0 \rightarrow u_{\bar{Q}} = U_{\bar{Q}0} = U_{DD}$

$$i_{D2} = I_{D20} = 0 \ , \quad i_{D5} = I_{D50} = K_n'\frac{W_5}{L_5}\left(U_{DD} - U_{GS0n}^0 - \frac{U_{DSzasn}}{2}\right)U_{DSzasn} = 345 \ \mu\text{A} \ ,$$

$$i_{C\bar{Q}} = I_{C\bar{Q}0} = I_{D20} + I_{D50} = 345 \ \mu\text{A} \ .$$

Nakon $\Delta t \rightarrow u_{\bar{Q}} = U_{\bar{Q}\Delta t} = U_{PO} = 0,85 \text{ V}$

$$i_{D2} = I_{D2\Delta t} = K_p'\frac{W_2}{L_2}\left(0 - U_{DD} - U_{GS0p}^0 - \frac{U_{DSzasp}}{2}\right)U_{DSzasp} = -198 \ \mu\text{A}$$

$$i_{D5} = I_{D5\Delta t} = I_{D50} = 345 \ \mu A$$

$$i_{C\bar{Q}} = I_{C\bar{Q}\Delta t} = I_{D2\Delta t} + I_{D5\Delta t} = 147 \ \mu A$$

$$I_{C\bar{Q}sr} = \frac{I_{C\bar{Q}0} + I_{C\bar{Q}\Delta t}}{2} = 246 \ \mu A$$

$$\Delta t = \frac{C_{\bar{Q}} \, \Delta u_{\bar{Q}}}{I_{C\bar{Q}sr}} = \frac{C_{\bar{Q}} \left(U_{DD} - U_{PO} \right)}{I_{C\bar{Q}sr}} = 11,6 \ \text{ps}$$

4. zadatak

a) $\quad X = \overline{A}\,\overline{B} + A\,B = \overline{A \oplus B} = \overline{P}$

b) $\quad Y = \overline{X}\,\overline{C_u} + X\,C_u = P\,\overline{C_u} + \overline{P}\,C_u = P \oplus C_u = A \oplus B \oplus C_u = S$

c) $\quad Z = \overline{X}\,C_u + X\,A = P\,C_u + \overline{P}\,A = C_i$

d) Čvor izlaznog prijenosa opterećen je s 4 kapaciteta osiromašenih slojeva i s 2 MOS kapaciteta.