Elektronische Schakelingen

Toets 1, 27 April

Uitwerking

Opgave 1

A. $V_{R_c} = \frac{1}{2}U_c = 3V$

$I_c = I_{R_c} = V_{R_c} / R_c = 300\mu A$

B. $g_m = \frac{I_c}{V_T} = \frac{I_c}{kT/q} \approx \frac{I_c}{25mV} = 12mA/V$

C. $\left.\begin{array}{l} \beta = \frac{i_c}{i_b} = 100 \\ g_m = \frac{i_c}{u_{be}} \end{array}\right\} Z_{in} = \frac{U_{be}}{i_b} = \frac{\beta}{g_m} = 8{,}3k\Omega$ (reëel $\rightarrow R_{in}$)

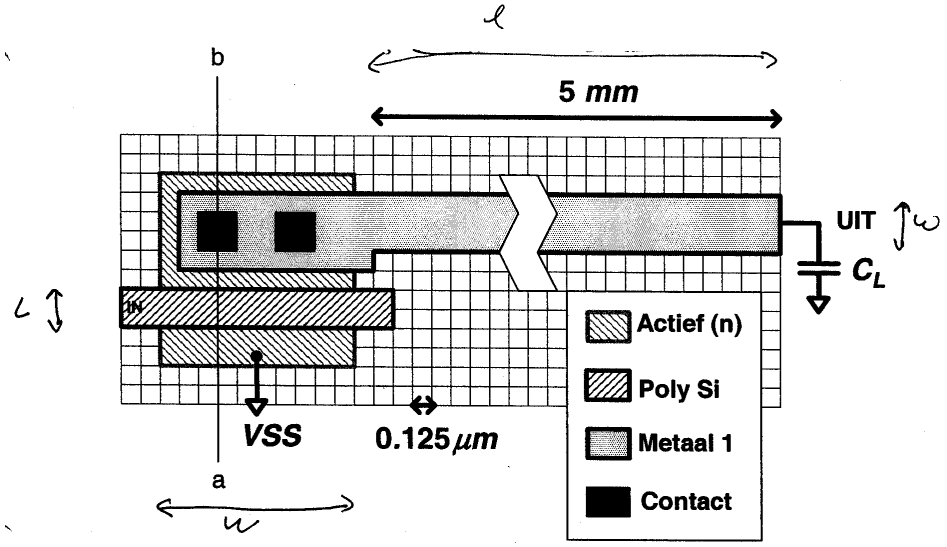
D. $f_k = \frac{1}{2\pi C_k R_{in}} \Rightarrow C_k = \frac{1}{2\pi R_{in} f_k} = 190nF$

E. $A_v = \frac{U_{ce}}{U_{be}} = g_m \cdot R_c = 120 \rightarrow V_{ce} = 120 \cdot 10mV_{eff} = 1{,}2V_{eff}$

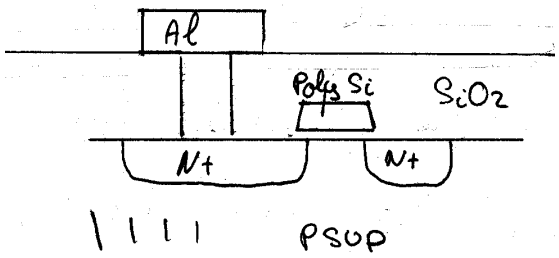
F. $P_{DC} = \frac{V_{R_c}^2}{R_c} = 900\mu W$

G. $P_{ac} = \frac{U_{ce}^2}{R_c} = 144\mu W$

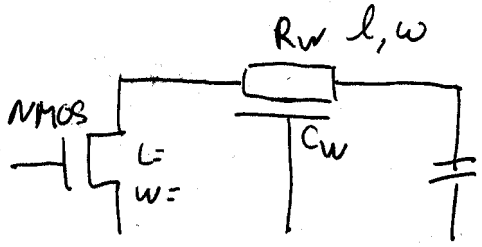
Opgave 2



A.



B.



C.

C.I. Waar. Chips zijn makkelijk groter dan 5mm aan een zijde, communicatie over zo'n afstand is nodig.

C.II. Niet waar.

$$R_w = \frac{l}{w} \times R_D = \frac{5000}{0{,}375} \times 0{,}1 = 1k3$$

$$R_{eq} = \frac{L}{W} \times 13k = 2k6$$

C.III. Waar. $C_W = l \times w \times C_a + 2l \times C_p = 5000 \times 0{,}375 \times 30 + 2 \times 5000 \times 40 = 456\,fF$

$$C_L = (L \times W)(C_{ox_m} + C_{ox_p}) = (0{,}25 \times 0{,}375)(6 + 6) = 1{,}125\ fF$$

C.IV. Waar. Het product R_wC_w in de expressie voor T_D kun je schrijven als:

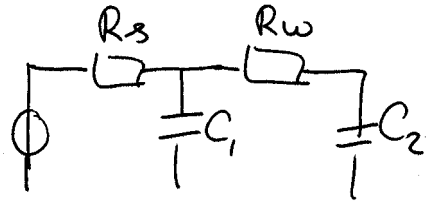
$$R_W C_W = \frac{l}{w} R_o (l \cdot w \cdot C_a + 2l \cdot C_p) = l^2 R_o C_a + 2l^2 R_o C_p / w$$

D. $R_S = 2k6$

$C_1 = ½C_w = 228fF$

$C_2 = ½C_w + C_1 = 229fF$

$R_w = 1k3$



E. $T_D = R_s C_1 + (R_s + R_w) C_2 = 2{,}6 \times 228 + 3{,}9 \times 229 = 1486\,ps(k\Omega \times fF) \approx 1{,}5ns$

$t_{50\%} = 0{,}69 T_D \approx 1ns$