

פתרון תרגיל 6

(1) הטרנזיסטור עובד בתחום הליניארי שהרי

$$V_D = 0.05 \text{ V} < (V_G - V_T) = 0.8 \text{ V}$$

$$\begin{aligned} g_d &= \left. \frac{\partial I_D}{\partial V_D} \right|_{V_G = \text{const.}} = \frac{Z}{L} \mu_n C_o (V_G - V_T) && \text{ולכן} \\ &= \frac{8}{0.5} \times 850 \times 10^{-7} \times 0.8 \\ &= 1.09 \times 10^{-3} \text{ S.} \end{aligned}$$

$$\begin{aligned} g_m &= \left. \frac{\partial I_D}{\partial V_G} \right|_{V_D = \text{const.}} = \frac{Z}{L} \mu_n C_o V_D \\ &= \frac{8}{0.5} \times 850 \times 10^{-7} \times 0.05 \\ &= 6.8 \times 10^{-5} \text{ S.} \end{aligned}$$

(2) מתח הסף הוא

$$V_T = 2\psi_B + \frac{2\sqrt{\epsilon_s q N_A \psi_B}}{C_o}, \quad \psi_B = 0.026 \ln\left(\frac{10^{17}}{9.65 \times 10^9}\right) = 0.42 \text{ V}$$

$$\therefore V_T = 0.84 + \frac{2\sqrt{11.9 \times 8.85 \times 10^{-14} \times 10^{17} \times 0.42 \times 1.6 \times 10^{-19}}}{10^{-7}} = 0.84 + 1.68 = 2.52 \text{ V}$$

g_m יהיה:

$$g_m = \left. \frac{\partial I_D}{\partial V_G} \right|_{V_D = \text{const.}} = \frac{Z}{L} \mu_n C_o (V_G - V_T) = \frac{8}{0.5} \times 850 \times 10^{-7} \times (4 - 0.7) = 4.49 \times 10^{-3} \text{ S.}$$

(3) מתח הסף הוא

$$V_T = V_{FB} + 2\psi_B + \frac{2\sqrt{\epsilon_s q N_A \psi_B}}{C_o}, \quad \psi_B = 0.026 \ln\left(\frac{10^{17}}{9.65 \times 10^9}\right)$$

$$\begin{aligned} V_{FB} &= \phi_{ms} - \frac{Q_f}{C_o} = -\frac{E_g}{2} - \psi_B - \frac{1.6 \times 10^{-19} \times 5 \times 10^{10}}{3.45 \times 10^{-7}} \\ &= -0.56 - 0.42 - 0.02 = -1 \text{ V} \end{aligned}$$

$$\begin{aligned} \therefore V_T &= -1 + 0.84 + \frac{2\sqrt{11.9 \times 8.85 \times 10^{-14} \times 10^{17} \times 0.42 \times 1.6 \times 10^{-19}}}{3.45 \times 10^{-7}} \\ &= -1 + 0.84 + 0.49 \\ &= 0.33 \text{ V} \end{aligned}$$