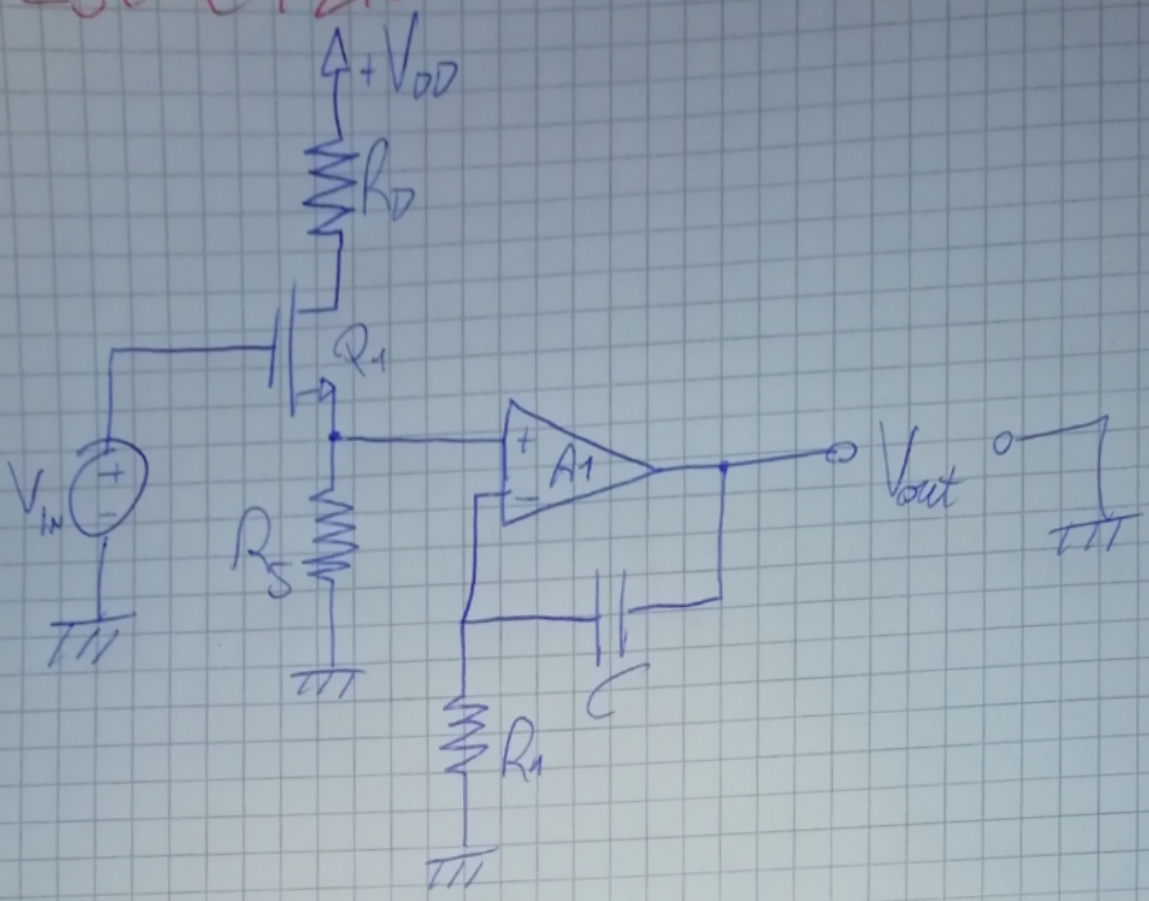
ESERCIZIO

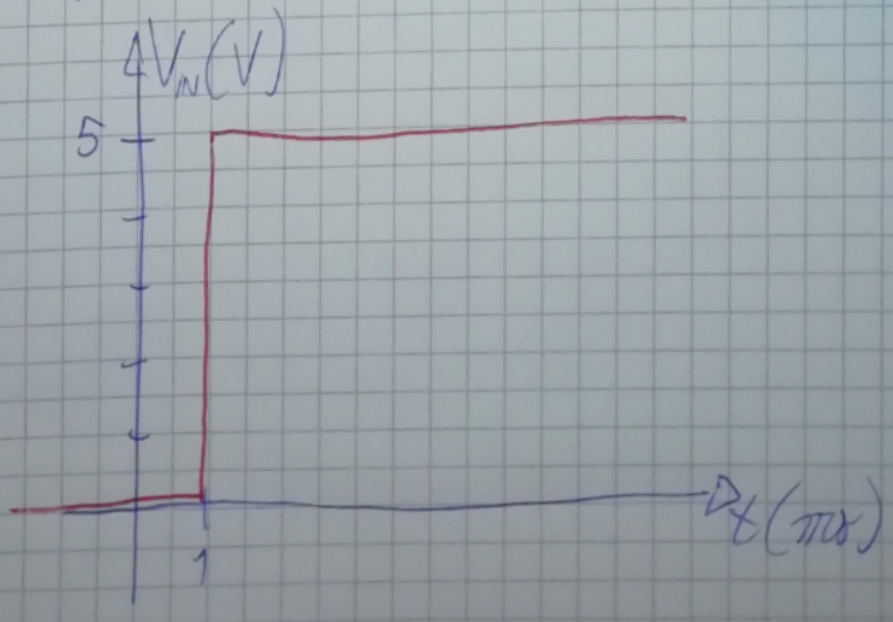


$V_{DD} = 10\,V$

$R_1 = 1\,K\Omega \quad R_D = 2\,K\Omega \quad R_S = 1\,K\Omega \quad C = 2\,\mu F$

$Q_1 = \{ V_t = 1\,V ; \; K = 0{,}5\,mA/V^2 ; \; \lambda = 0 \}$

$L^+ = |L^-| = 5\,V$



$V_{GS} > V_t$

$V_{GS} = V_G - V_t = V_{IN} - I_D R_S$

$t < 1$

$V_{IN} = 0$

$$\begin{cases} V_{GS} = -i_D R_S \\ i_D = K(V_{GS} - V_t)^2 \end{cases}$$

$$V_{GS} = -\frac{1}{2}(V_{GS} - 1)^2$$

$$-2V_{GS} = V_{GS}^2 - 2V_{GS} + 1$$

$$V_{GS}^2 + 1 = 0$$

V_{GS}

$V_{GS} = 0 < V_t = 1$

Q_1 interdetto

$V^+ = 0V$

$V_{out} = 0V$

$t \geq 1 \quad V_{IN} = 5V$

$$\begin{cases} V_{GS} = V_{IN} - i_D R_S \\ i_D = K(V_{GS} - V_t)^2 \end{cases}$$

$$i_D = K(5 - i_D - 1)^2 = \frac{1}{2}(4 - i_D)^2$$

$$2i_D = 16 - 8i_D + i_D^2$$

$$i_D^2 - 10 i_D + 16 = 0$$

$$\Delta = 100 - 64 = 36$$

$$i_{D1,2} = \frac{10 \pm 6}{2} = \begin{cases} + \; 8 = i_{D_1} \\ - \; 2 = i_{D_2} \end{cases}$$

$$V_{GS_1} = 5 - 8 = -3V < V_t = 1V$$

$$V_{GS_2} = 5 - 2 = 3V > V_t = 1V$$

$$i_D = 2\,mA \qquad V_{GS} = 3V$$

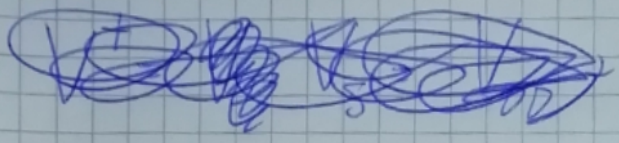
$$V_{DS} > V_{GS} - V_t = 3 - 1 = 2V$$

$$V_{DS} = V_D - V_S = V_{DD} - i_D R_D - i_D R_S =$$

$$= 10 - 2 \cdot 2 - 2 = 10 - 4 - 2 = 4\,V$$

$V_{DS} > V_{GS} - V_t$ verificata

Q_1 in saturazione



$$V^+ = V_S = i_D R_S = 2\,V$$

$$V_{out} = \frac{1}{R_1 C} \int V^+ dt = \frac{V^+}{R_1 C} t = \frac{2}{2 \cdot 10^{-3}} t = 1 \frac{V}{ms} t$$

$$R_1 C = 10^3 \cdot 2 \cdot 10^{-6} = 2 \cdot 10^{-3}$$