

**MOS-transistor exercise:****Slide page 28 (lower)**

1. Calculate the ratio of leakage current  $I_{ds}(V_{gs}=0V)$  to the drain-current  $I_{ds}(V_{gs}=V_t)$  of a NMOS-transistor with the following parameters:

$V_t=0.5V$  (threshold voltage)

$v_T=26mV$  (thermal voltage)  $(I_{ds}(V_{gs}=0)/I_{ds}(V_{gs}=V_t)) = 2.7 \cdot 10^{-6}$

$n=1.5$  (process factor)

$V_{ds} \gg v_T$

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2. Calculate the minimum threshold voltage  $V_t$  of a NMOS-transistor if its leakage current for  $V_{gs}=0V$  needs to be 1/1000 or less compared to its drain-current for  $V_{gs}=V_t$ . Assume:  $v_T=26mV$ ,  $n=1.5$ ,  $V_{ds} \gg v_T$   **$V_t \geq 0.269 V$**

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3. Assuming a NMOS-transistor with a nominal threshold voltage  $V_{t0}=0.4V$  in a 90nm CMOS process. Calculate the actual threshold voltage of this device if source is on 1.1V! Assume a surface potential of  $\Phi_s=0.93V$  and a body effect coefficient of  $\gamma=0.6\sqrt{V}$ .  **$V_t = 0.68V$**

class: Tue,Nov/7