

Task 2.1

An inverter exhibits a measured delay of 2ns.

- a) Calculate the delay of 5 inverters connected in series (Fig. 2.1):

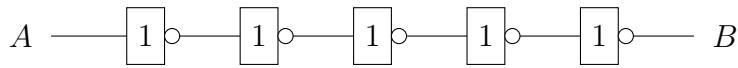


Figure 2.1: Chain of 5 inverters

- b) When A and B are connected, a clock can be excited. Specify period and frequency:

Task 2.2

Create the structure and symbol of an NMOS transistor and calculate the cross current I_{DC} in steady state:

Task 2.3

In 130nm, carrier concentrations are used in the p-substrate in the range of $3 \cdot 10^{17} \text{ cm}^{-3}$. The thickness of the oxide is $t_{\text{ox}} = 22 \text{ \AA}$, the doping of the gate is $N_D = 10^{20} \text{ cm}^{-3}$.

- a) Estimate the degree of band-bending for strong inversion at room temperature (relative to the flat-band condition):
- b) Calculate the maximum width and charge of the space charge region for strong inversion:
- c) Provide the values of the oxide capacitance C_{ox} and the body factor γ :
- d) $N_{\text{ox}} = 2 \cdot 10^{10} \text{ cm}^{-2}$ is given. Provide the threshold voltage of $V_{\text{SB}} = 0 \text{ V}$ and discuss the gate doping:
- e) Determine the ions to be implanted (N_I in units [ion/cm^2]) required to reach a threshold voltage of 0.4 V :