

WS 2019/20

Tutorial for Microelectronics III

2. Basic Principles of Transistor

Task 1:

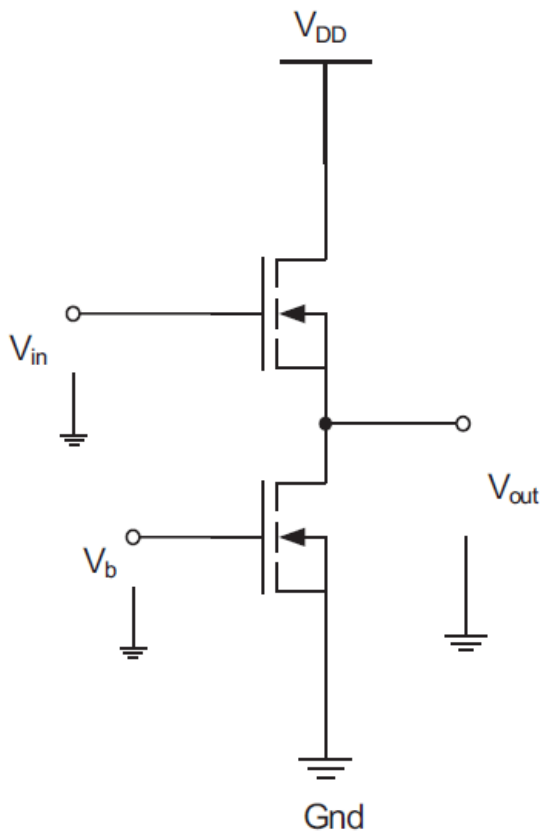


Figure 1

- Which type of circuitry does the circuit in Figure 1 belong to?
- Please sketch the transfer characteristic of V_{out} in dependence of V_{in} (from 0 to V_{DD}) and mark the important points. In which range do the transistors T_1 and T_2 work?
- Please dimension the transistors T_1 (top) and T_2 (bottom) so that the following specifications are fulfilled:

- $I_d = 0.5\text{mA}$
- $\beta_{0n} = 100 \mu\text{A/V}^2$
- $V_{th1,2} = 0.7\text{V}$
- $V_b = 1.5\text{V}$
- $r_{out} = 2\text{k}\Omega$

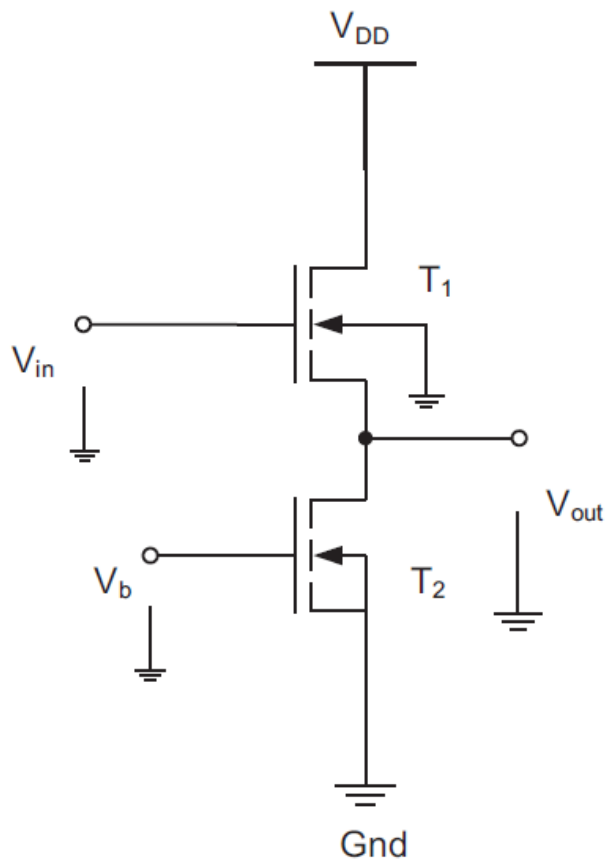


Figure 2

d) The bulk of T1 is now connected to ground (as shown in figure 2). Which parameter of the transistor is affected?

This is given:

$$V_{th0} = 0.7V$$

$$V_{DD} = 5V$$

$$I_d = 0.5mA$$

$$\gamma = 0.45 V^{1/2}$$

$$2\phi_D = 1.2$$

$$\beta_{0n} = 100\mu A/V^2$$

Please dimension T1 for achieving the maximum output voltage $V_{out} = 3.5V$.