

ECE 3030: Physical Foundations of Computer Engineering

Spring 2024

Homework 10—Total points 100

Q1 What are the reasons that, in an inverter, you would want the PMOSFET to be wider than the NMOSFET? Write at least two reasons. [Total 20 pts]

Q2 **SRAM Array:** Consider the SRAM array shown in figure 1. Say you want to read all the cells in row 2. What is the sequence of operation you will need to perform? Make sure that, after your prescribed operations, you keep the data in the cells you read intact. [Total 30 pts]

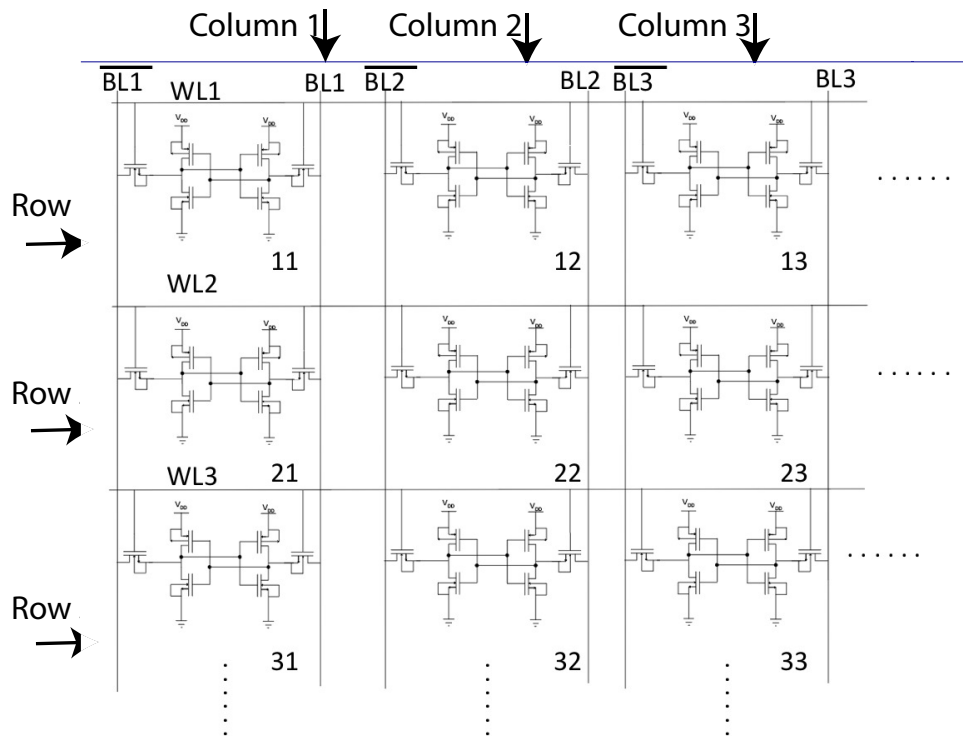


Figure 1: An SRAM array.

Q3 Consider an inverter operating a power supply voltage V_{DD} . Assume that $\mu_n/\mu_p = 3$ and $(W_p/L_p)/(W_n/L_n) = 3$. Make the necessary assumptions to get to an answer for the following questions. [30 pts]

[Q3.1] How will the delay and active power per device change as you increase V_{DD} ? Explain with equations.

[Q3.2] How will the delay and active power per device change as you increase the doping density of both the N- and the P-MOSFET? Explain with equations.

[Q3.3] How will the noise margins change as you increase the doping density of both the N- and the P-MOSFET? Explain with equations and figures.

Q4 Explain the concept of fanout and its significance in CMOS inverter design. Discuss why it is advisable to have a higher fanout for the PMOSFET compared to the NMOSFET in CMOS inverters. Provide at least two reasons. [20 pts]