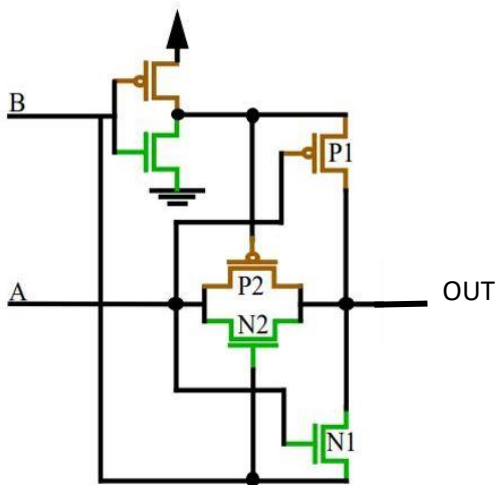


CME 342 QUIZ #1

This is an open book exam, the duration is 90 minutes. You need to scan and submit your work by end of the exam. The total points are 50.

1. Draw and label the terminals and substrate of an NMOS and a PMOS transistor cross-section forming a CMOS inverter, including the well(s). Briefly explain the biasing conditions of the source, drain and well(s) when 0V is applied to the input. (10 points)

2. For the following transistor level schematic, find out the truth table of the circuit, for the OUT. Under each of the four input combinations, label the **output** as ‘strong’ or ‘weak’ logic 0’s or 1’s. If it is a strong 0’ or 1’, explain the source (using the labels P1, P2, N1 and N2) for each input combinations. Note, the weak logic 0’ or 1’, means that the logic value is degraded. (10 points)



Fill in the table for your answers

A	B	OUT	Strong or weak	source
0	0			
0	1			
1	0			
1	1			

3. Design a CMOS XNOR gate: $F = \overline{A \oplus B} = A \cdot B + \overline{A} \cdot \overline{B}$, with minimal number of transistors. Assume the complementary of inputs A and B are available. Show your work. (10 points)

4. Design a static CMOS gate that implements the function. (12 points)

$$F = \overline{(A + B) \cdot (C + D)}$$

- (1) Draw the schematic of the compound static CMOS gate.
- (2) Indicate the appropriate sizes for all the transistors in the circuit so that it has the same driving capability as a unit-size inverter at worst case. State any assumptions made.
- (3) Draw the stack diagram of the layout with color codes, and label the layers. Also estimate the area of the gate.

5. Draw the transistor schematic representing the circuit below. Can you describe the function of the circuit? (8 points)

