CpE311 – Test II, F02

Name (1 Point)_____

Show all your work in the space provided. Answers with a simple "yes", "no", or a single number are typically incomplete and will not be given full credit. Answers in non-reduced form, like (a+sqrt(b))/c, are fine where appropriate. Good English on essay/short answer questions is required. ON MULTIPLE CHOICE QUESTIONS, IF YOU'RE NOT SURE GUESS CAREFULLY– you will get points off for wrong answers. If you know part of an answer, write what you know for partial credit.

1. (15 Points) Draw a transistor-level diagram of an OAI31 gate. Use as few transistors as possible without using transmission gates or other "unconventional" methods. You do not have to include shape factors for the transistors.

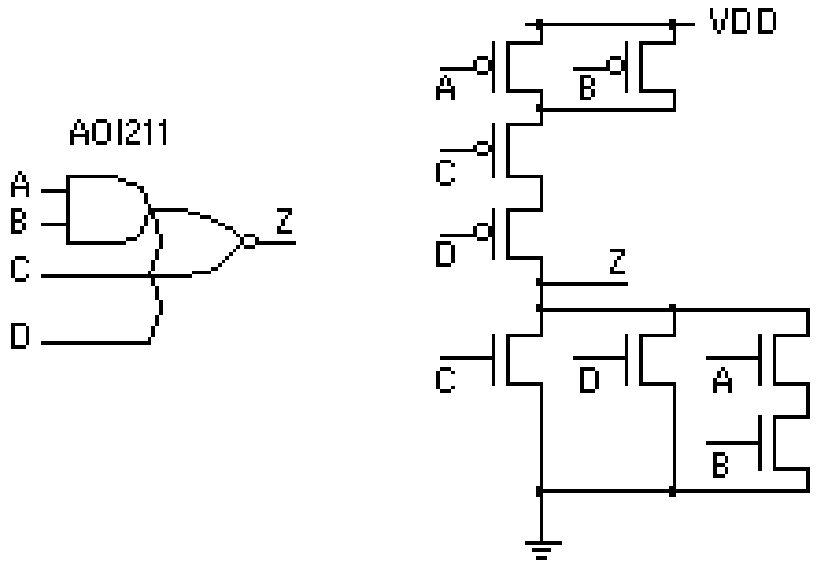
2. (4 Points) Give the minimum values, in λ, for each of the following when fabricating a chip through MOSIS.
    a. Width of a transistor.

    b. Length of a transistor

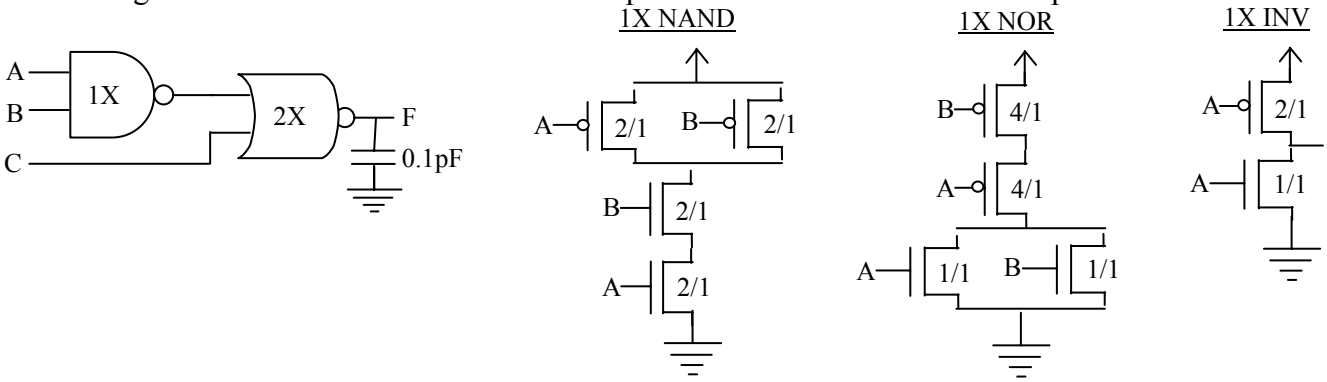
    c. Width of M1 at an M1/poly contact (e.g. the overall width of the contact)

    d. Separation between M3 traces.

3. (15 Points). Following is a transistor-level diagram of an AOI211**X2** gate. Fill in the shape factors for each transistor. Assume $K_n = 1.5\ K_p$ (this is different than we've been using in class! If you get confused, use $K_n = 2K_p$, as we have in class, for partial credit). Assume a minimum sized transistor has a 2/1 shape factor.



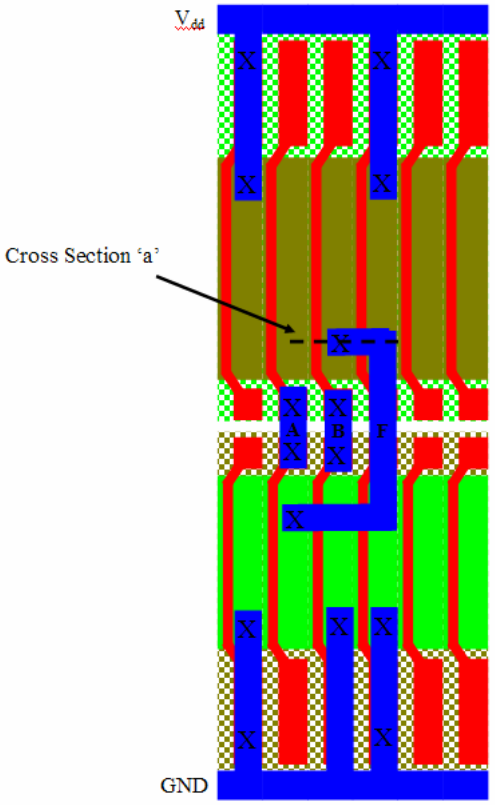
4. Assume the circuit on the left was created using the Compass 0.5 micron process. To make your life easy, transistor level implementations of some gates are shown on the right. Note that the NAND is a 1X component and the NOR is a 2X component.



a. (10 Points) Find g, the logical effort, for each component (the NAND and NOR in the circuit on the left).

b. (15 Points) Find the approximate time delay from input (A) to output (F) in the circuit on the left.

5. For the layout on the right (also shown on overhead):
   a. (15 Points) Draw a transistor level schematic and describe the logic function performed.



   b. (10 Points) Draw the cross-section given at the line "a". Clearly indicate each material (poly, M1, SiO_2, etc). Please use color if possible.

6. (5 Points) For a 0.5 micron process, λ equals:

a) 0.25 micron b) 0.5 micron c) 0.75 micron
d) 1.0 micron e) No way to tell f) None of the above

7. (10 Points) What is the purpose of the connection to V_{dd} or V_{ss} at the well (from an electrical standpoint)? (Please limit yourself to no more than 3 sentances).