Exam 2

ECE 559: MOS VLSI Design (Fall 2009)

ECE Department, Purdue University

November 5, 2009

Name: _____

PUID: _____

Instructions: It is important that you clearly show your work and mark the final answer clearly, closed book, closed notes, no calculator.

Time: 1 hour 15 minutes

Scoring

Problem 1 (Total 30 points)

Part a) 10 points _____

Part b) 10 points _____

Part c) 10 points _____

Problem 2 (Total 40 points)

Part a) 10 points _____

Part b) 10 points _____

Part c) 10 points _____

Part d) 10 points _____

Problem 3 (30 points) _____

Total: 100 points _____

Problem 1: **[30 points]**

Part a) Draw *positive* and *negative* C^2MOS latches. Clearly show the applied clock signals.
[10 points]

Part b) Implement NOR operation **using static logic** as a pipelined datapath using C^2MOS latches that *avoids any race-condition due to clock overlaps*. Clearly draw all the transistors and the applied clock signals in your diagram. Write your assumptions, if any.

[10 points]

Part c) Implement NOR operation **using dynamic logic** as a pipelined datapath using C^2MOS latches that *avoids any race-condition due to clock overlaps*. Clearly draw all the transistors and the applied clock signals in your diagram. Write your assumptions, if any.

[10 points]

Problem 2: Consider the edge-triggered register shown below. Clearly and concisely answer the following questions with explanation. Write your assumptions, if any.

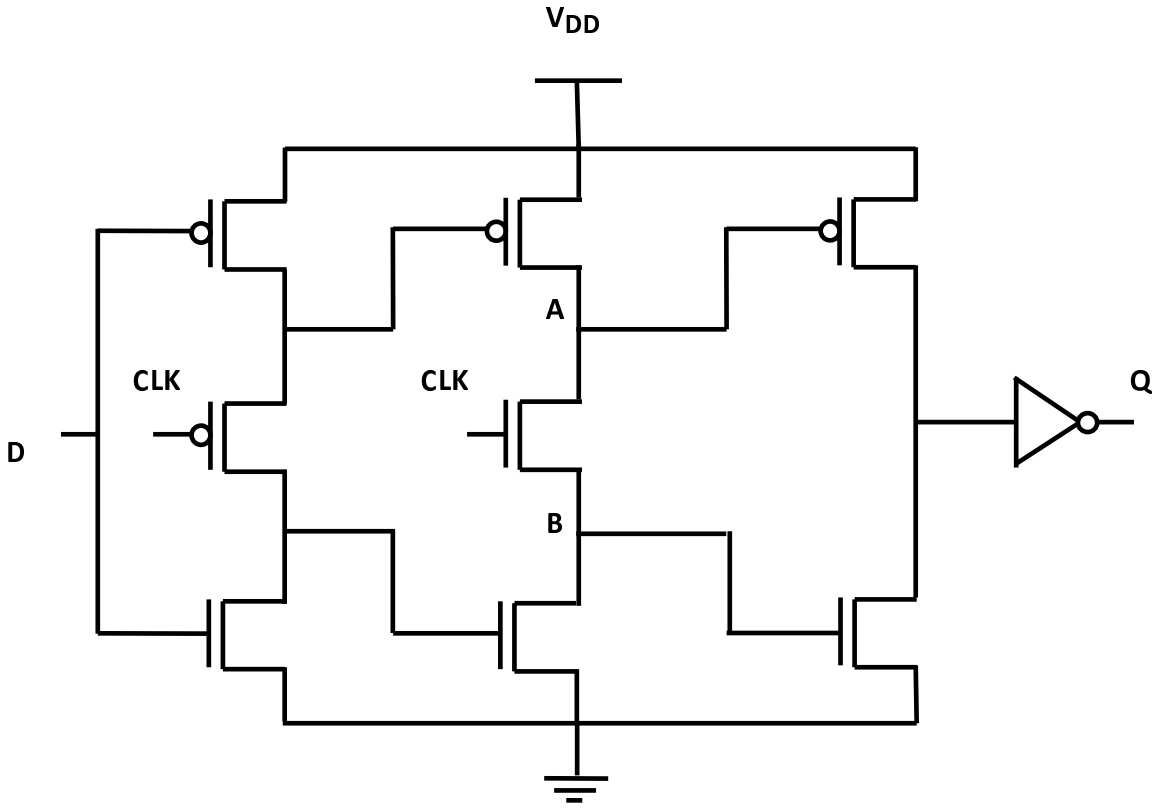
[40 points]

a) What are the minimum and maximum voltages possible at the nodes A and B? **[10 points]**

b) Determine the set-up time. **[10 points]**

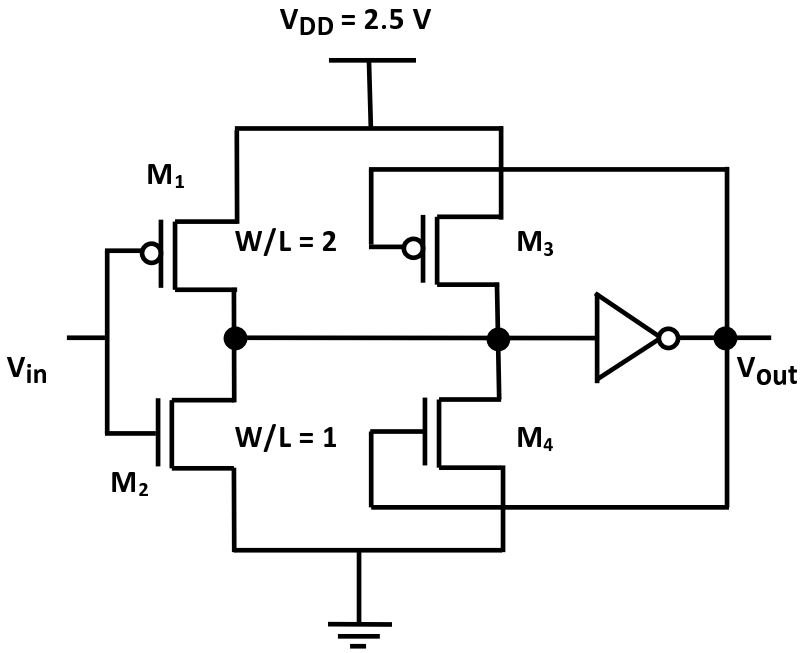
c) Determine the propagation delay. **[10 points]**

d) Determine the hold time. **[10 points]**



Problem 3: Consider the Schmitt trigger circuit shown below. Find the widths of the transistors M_3 and M_4 to have V_{M-} = 1 V and V_{M+} = 2 V. Clearly write the *regions of operation* of the transistors during your calculation and write your assumptions, if any.

[30 points]



$K_p' = \mu_p C_{ox}$ = 50e-6 A/V^2

$K_n' = \mu_n C_{ox}$ = 100e-6 A/V^2

V_{tp} = -0.5 V, V_{tn} = 0.5 V

L = 300 nm

Scratch Paper 1

Scratch Paper 2