

**UNIVERSITY OF CALIFORNIA**  
**College of Engineering**  
**Department of Electrical Engineering and Computer Sciences**  
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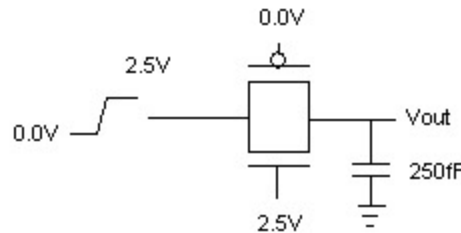
*Homework #7*

*EECS 141*

*Due Date: Wednesday, October 31, 2000 (Halloween!) at 5:00pm in drop-box outside 275 Cory*

**1. Performance of Transmission Gates**

As we have learned (or will learn soon!), pass transistors are not ideal switches. Consider the transmission gate below.  
 Figure 1: Transmission gate -



The input switches from 0.0V to 2.5V and the transmission gate drives a 250 fF load. Both the NMOS and PMOS are minimum sized (remember how big that is?).

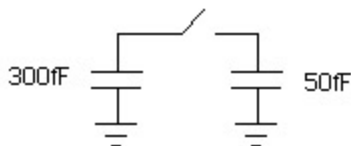
- a) Calculate the transmission gate resistances ( $R_n$ ,  $R_p$ , and  $R_{cq}$ ) in 0.5V steps as the output voltage switches from 0.0V to 2.5V. Graph these resistances on the same graph.  
*(Two pieces of advice: 1) Don't forget body effect!; and 2) Equations 6.22 and 6.23 won't work for the whole range!)*
- b) What is the propagation delay  $t_p$  of this gate?

**2. Happy fun dynamic logic**

Dynamic logic is fun! Hopefully you'll still think so after this problem....

- a) Implement the following function in dynamic logic:  $F = ((A+B)C)'$
- b) Cascade the output of the circuit into a second stage to implement  $F = (((A+B)C)' + D)'$
- c) Will the circuit in part b work correctly? Why or why not? If not, give an example of when the circuit works incorrectly.
- d) The logic function in part b annoys your friendly TA (annoyed TA's give hard problem sets!). Please help me out. I don't like having too many inversions (the ') in a logic function. Write the equivalent function with only one ' in it.  
*Hint: If you don't understand what I mean, I don't like multiple levels of inversion like  $(A'+B)'$  if it is possible to avoid. Think, what does  $(A'+B)'$  equal?*
- e) Draw a domino implementation of the circuit in part b/d.
- f) This part has nothing to do with the previous parts except it is also a dynamic circuit. Draw a multiple output domino circuit with two outputs: AB and  $BAC + DAB$ .

**3. The arbitrary problem**



- a) The 300fF capacitor is initially at 2.5V, while the 50fF capacitor is initially at 1.0V. When the switch is closed, what will the final voltage on each capacitor be? What is the change in energy in energy between the initial and final states?
- b) Why do you think we are asking you this question (i.e. what does this have to do with dynamic circuits)?

We promised an easy problem set this week! I hope you agree... Good luck on your project progress =). No more homework for some time...