EECS 42 – Introduction to Digital Electronics

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Midterm # 2

(November 6th, 2003)

Closed Book, Closed Notes
Device Equations on Device Problem
Write on the Exam paper

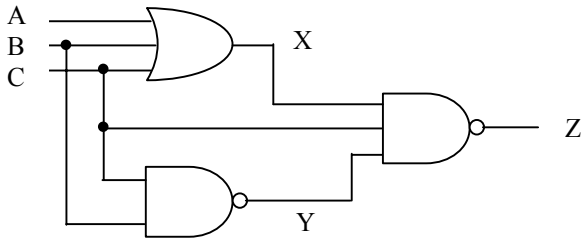
Print Your Name:_____

Sign Your Name:_____

Show your work so that the method as well as the answer can be graded for correctness and completeness. Correct answers alone are only worth 70% of full credit.

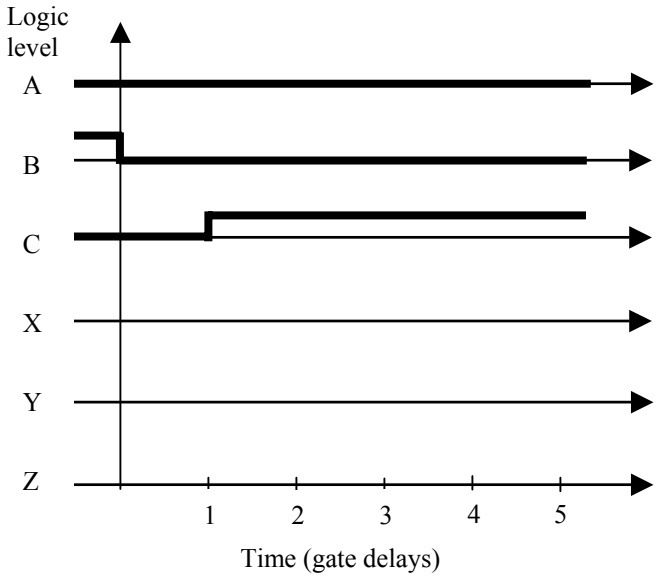
Problem	Possible	Score
I	25	
II	25	
III	28	
IV	22	
Total	100	

I (25 Points) Logic and Timing Diagrams

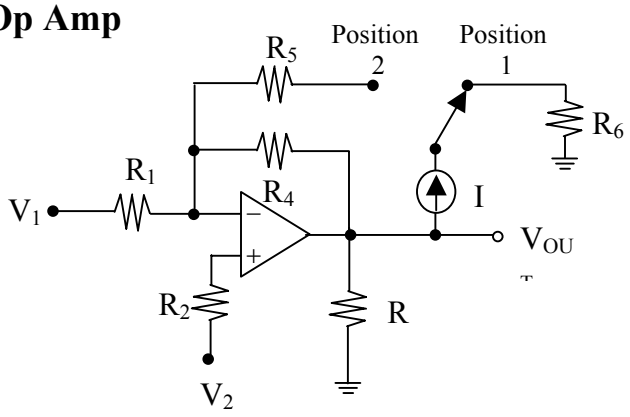


a) (9 points) Using the inputs in the diagram, determine the initial and final values of X, Y, Z.

b) (16 points) For each of the outputs, circle (with an "o") when new information is received and complete the timing diagram.



II (25 Points) Op Amp



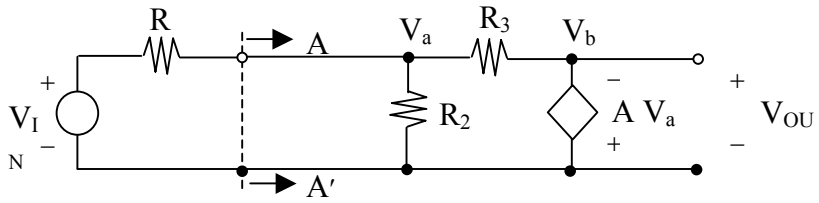
a) (10 points) Find V_{OUT} in terms of V_1, V_2, and I, and the resistors R_1, R_2, R_3, R_4, R_5, R_6 when the switch is in position 1.

b) (15 points) Assume the switch is now in position 2.
   1. Give an equation that could be solved to find the new V_{OUT}.

   2. Specify those and only those sources and resistances that will appear in the answer.

   3. State if the proportionality between V_{OUT} and V_1 will change or not. Briefly explain your answer.

III (28 Points) Dependent Source Analysis



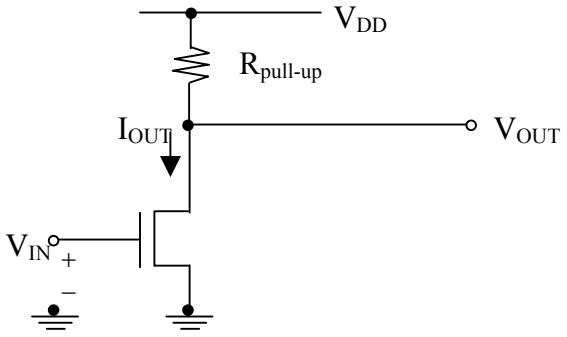
a) (10 points) Find one equation between V_{IN} and V_{OUT} with no other voltages.

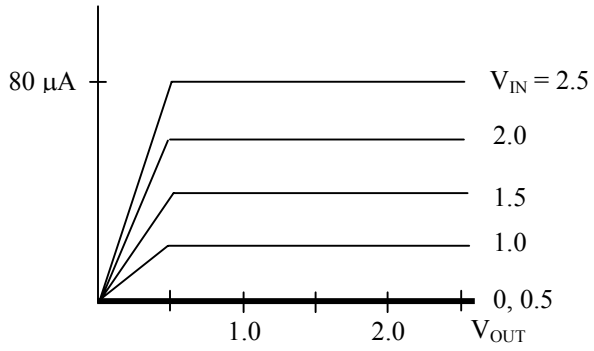
b) (12 points) Find the equivalent resistance looking to the right of the AA′ cut-line.

c) (6 points) If A is large and if R_1 and R_2 are similar, will the equivalent resistance found in part b) be much larger, the same, or much smaller than R_1 and R_2 by themselves? Give an intuitive explanation.

IV (22 Points) Logic Circuit with an EE42 Device

Use the I versus V curves shown to the right and assume V_{DD} = 2.5V.





a) (10 points) Choose a pull-up resistance that will make $V_{OUT} = V_{IN} = V_{MID} = 1.25V$.

b) (12 points) Assuming, (W/L) =4, find V_{Tn}, $V_{SAT\_SAT\_n}$, and k′ for this NMOS device graph?

$$I_{OUT-SAT-n} = k'_n \left(\frac{W}{L}\right)_n \left(V_{IN} - V_{Tn}\right) V_{OUT-SAT-n}$$

$$I_{OUT-SAT-p} = k'_p \left(\frac{W}{L}\right)_p \left(V_{DD} - V_{IN} - |V_{Tp}|\right) V_{OUT-SAT-p}$$