EECS 42 – Introduction to Electronics for Computer Science

Fall 2001, Prof. A. R. Neureuther
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Midterm #2 November 7th, 2001

Closed Book, Closed Notes
Write on the Exam paper

Print Your Name:_____

Sign Your Name:_____

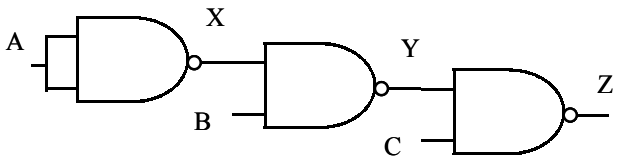
Show your work so that the method as well as the answer can be graded for correctness and completeness. Correct answers alone are only worth 70% of full credit.

Problem	Possible	Score
I	30	
II	25	
III	22	
IV	23	
Total	100	

I (30 Points) Logic and Timing Diagrams

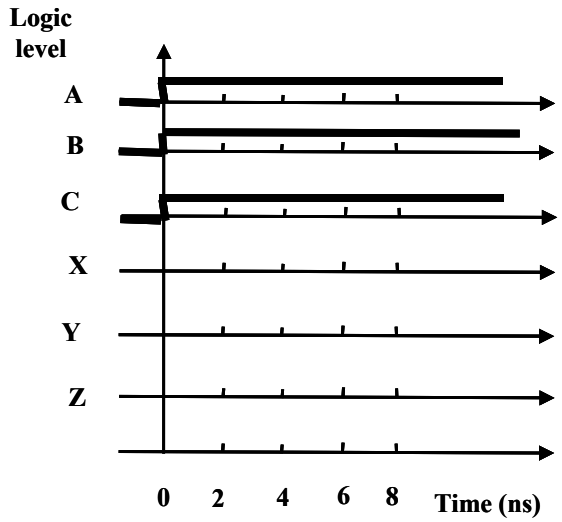
Inputs A, B, and C have all been zero (low) for a long time and then at t = 0, A, B and C go to (high) for a long time.

a) (5 Points) Find the values of X, Y and Z just before t = 0, and then as t goes to infinity.

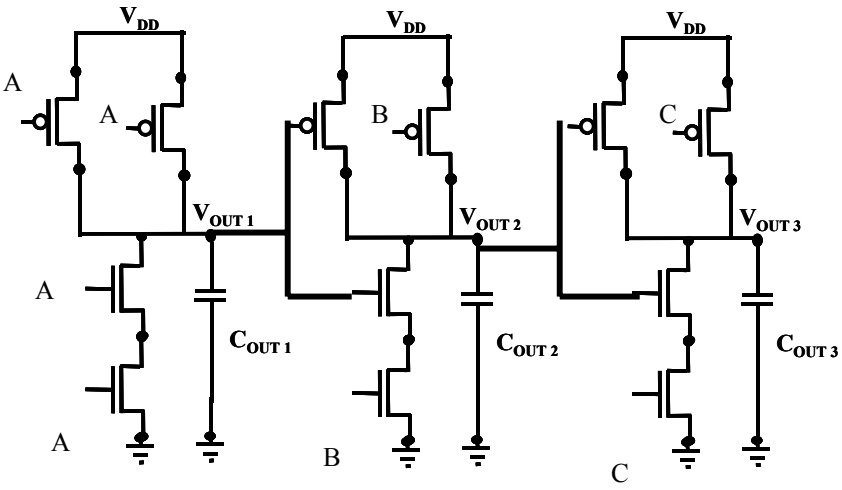


	Before t =0	As t => infinity
X		
Y		
Z		

b) (10 Points) Complete the timing diagram to the right assuming that each gate has a propagation delay of 2 ns before the correct output appears at its output.



c) (7 Points) For the CMOS circuit implementation to the right of the NAND gate logic circuit above and the signal changes in part a), **find the time at which the change reaches $V_{OUT\ 1}$.** State the delay in terms of 0.69RC using R_U and R_D (from the switched resistor device models) and the capacitors shown.

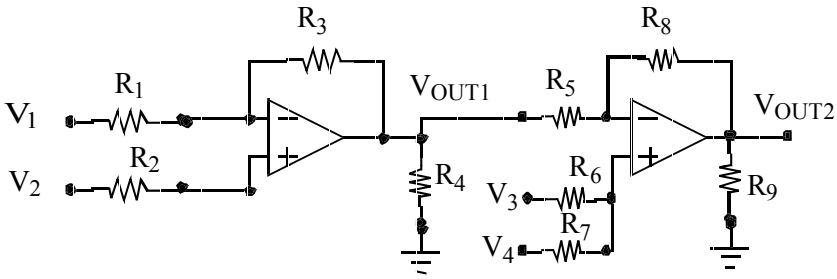


d) (8 Points) For the CMOS circuit implementation to the right of the NAND gate logic circuit above and the signal changes in part a), **find the time at which the change reaches $V_{OUT\ 3}$.** State the delay in terms of combinations of 0.69RC using R_U and R_D (from the switched resistor device models) and the capacitors shown.

II (25 Points) Ideal Op-Amp Analysis

Use the ideal op-amp analysis method in this problem.

a) (8 Points) Find V_{OUT1} in terms of the resistances and input voltages.



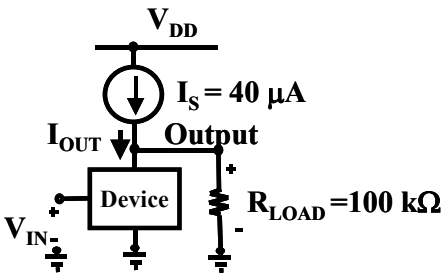
b) (9 Points) Give sufficient additional equations for finding V_{OUT2} in terms of the resistances and input voltages. Do not solve.

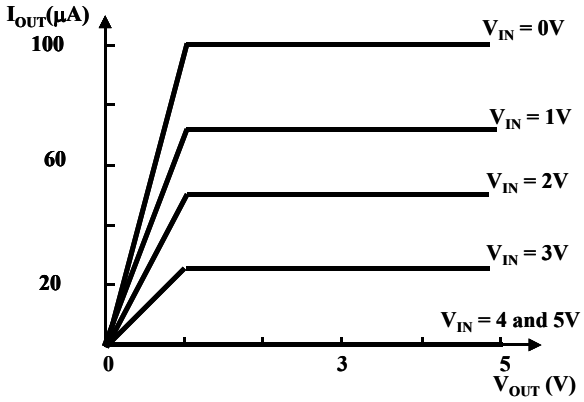
c) (8 Points) Assume that $V_{OUT2} = k_1V_1 + k_2V_2 + k_3V_3 + k_4V_4$. For i = 1,4 complete the table below by determining the sign of k_i and listing the resistors that will contribute to k_i. Hint: Start with what you know from part a) to reach $V_{OUT\,1}$ and then apply this principle again.

Term number i	Sign of k_i	Resistors Contributing to k_i
V1		
V2		
V3		
V4		

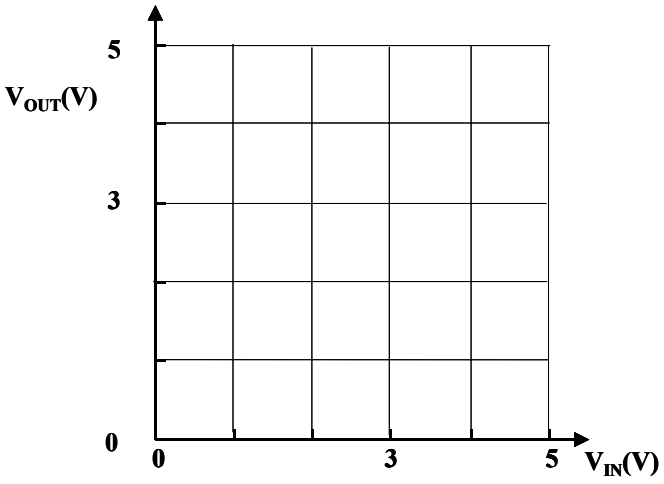
III (22 Points) Device I vs. V Curves

a) (10 Points) For the logic circuit and device characteristics shown find V_{OUT} when V_{IN} = 3V.



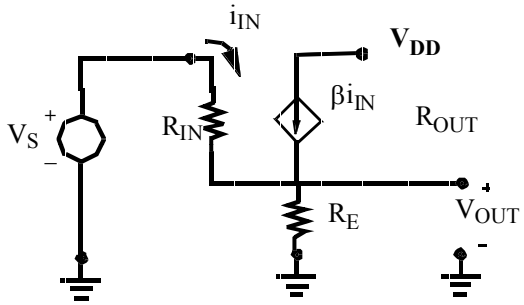


b) (12 Points) For the logic circuit shown, approximately sketch the voltage transfer function V_{OUT} vs. V_{IN}. Specify values of V_{OUT} for V_{IN} = 0, 3 and 5V.



IV (23 Points) Advanced Circuits with Dependent Sources

a) (10 Points) Find V_{OUT}/V_{IN}.



b) (13 Points) Find the Thevenin resistance looking into the output.