NCSU ECE 109 Sections 602 and 603 and UNCA CSCI 255.001
Exam 1 Spring 2009
17 February, 2009

This is a closed book and closed notes exam. It is to be turned in by 5:45 pm. Calculators, PDA's, cell phones, and any other electronic or communication devices may not be used during this exam.

Please read and sign the following statement:

I have neither given not received unauthorized assistance on this test.

Name:_____

If you want partial credit for imperfect answers, explain the reason for your answer!

Problem 1 (8 points) Decimal to two's complement conversion
Convert the following four signed decimal numbers into five-bit two's complement representation.

8	5
-1	-10

Problem 2 (8 points) Two's complement to decimal conversion
Convert the following four six-bit two's complement numbers into signed decimal representation.

000101	100001
010010	110010

Problem 3(8 points) Adding
Add the following pairs of seven-bit two's complement numbers **and indicate which additions result in an overflow**.

1000001 + 1000001	1110000 + 1110000
1111000 + 0001111	0100011 + 0011110

Problem 4 (10 points) Ranges
What is the number of different values that can be represented by 8 binary digits?

What is the greatest number that be represented in 8-bit two's complement notation?

What is the smallest number that can be represented in 8-bit two's complement notation?

What is the greatest number that be represented with an 8-bit unsigned number?

What is the smallest number that be represented with an 8-bit unsigned number?

Problem 5 (9 points) Floating point
Express the following three numbers in IEEE floating point notation. I've left some spaces between the major bit fields in the number, and I've also expressed the numbers in both decimal and binary fixed point notation. None of these answers should involve long calculations.

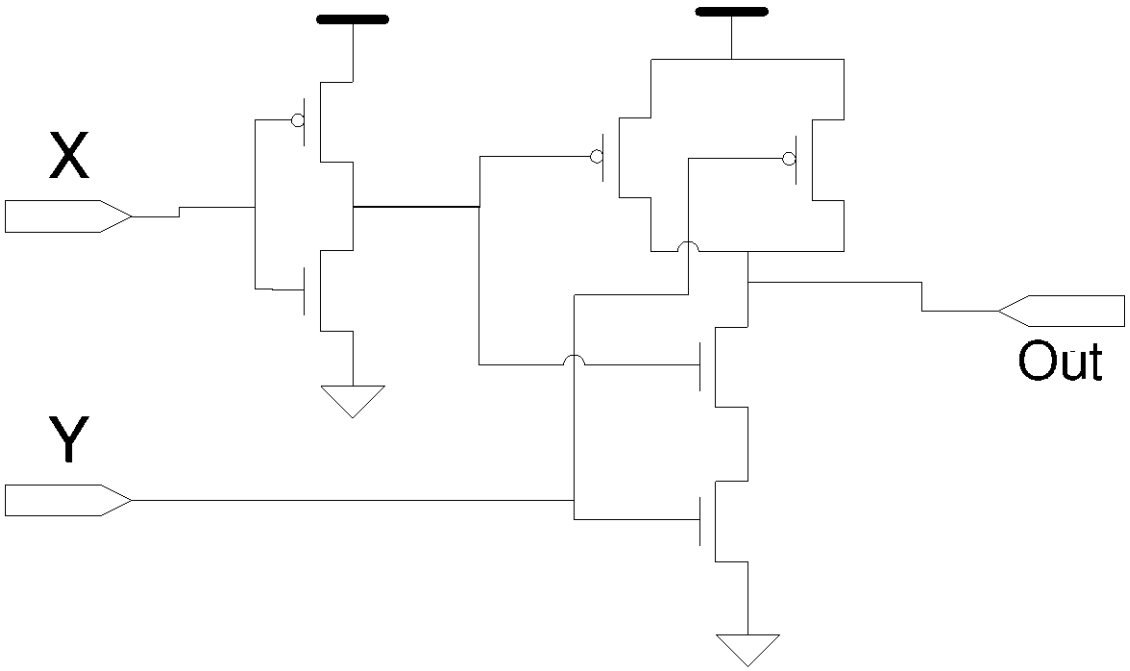
0.375 *or* 0.011 - -------- ----------------------
1.25 *or* 1.01 - -------- ----------------------
-256.0 *or* -100000000.0 - -------- ----------------------

Problem 6 (10 points) Transistors
In the space below, draw a transistor-level implementation of a 3-input NAND gate.

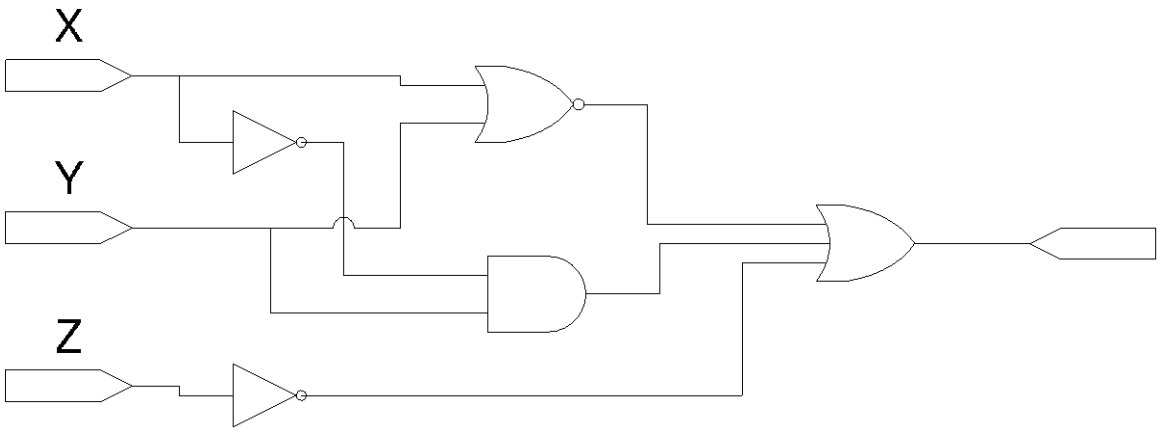
Problem 7 (4 points) Speed
Which would you expect to be able to transmit a signal faster: an AND gate or a NAND gate?

Give a one or two sentence justification for your answer.

Problem 8 (10 points) CMOS to truth
Give the truth table for the CMOS circuit shown below. The inputs are on the left, the output is on the right.



Problem 9 (10 points) Gates to Truth
Give the truth table for the gate-level circuit shown below. The inputs are on the left, the output is on the right.



Problem 10 (9 points) Bitwise operations
Perform the following bit-wise logical operations on 8-bit numbers expressed as two hexadecimal digits. Your answer should also be expressed in hexadecimal.

ADD(3A,78) -->
AND(3A,78) -->
OR (3A,78) -->

Problem 11 (2 points) Sign extension
What is the result of sign extending the following six-bit two's complement numbers to eight-bit two's complement numbers?

111000	000111
_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _

Problem 12 (12 points) Truth to Gates
Draw a circuit, at the gate level, that will implement the following truth table, where A, B, and C are inputs and where Z is the single output.

A	B	C	Z
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1