ECE 109 Sections 602 to 605
Exam 1 Fall 2007
26 September, 2007

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.

Violation of these rules will be considered a violation of the NCSU Code of Student Contact.

Please read and sign the following statement:

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

Name: ________________________________

Show your work if you want it to be considered for partial credit!

The following table should be sufficient for meeting the requirements of this test. If you ever feel the need for a calculator, you are probably on the wrong track.

Power of 2 table

-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	1024

Problem 1 (9 points) Memories

a) How many **bits** are in a memory with 4K words and a word size of 16?

b) How many **bits** are required to address a memory with 32K words?

c) How many 16-bit words can be stored in an 8 KB memory?

Problem 2 (12 points) Addition and overflow
Add the following pairs of six-bit two's complement numbers **and indicate which additions result in an overflow**.

111111 + 000100	011111 + 101000
110000 + 111000	011111 + 000100

Problem 3 (12 points) Decimal to two's complement
Translate the following four decimal numbers into six-bit two's complement numbers. Show your work in the space below!

24	-20
-1	33

Problem 4 (8 points) Floating Point
In this problem, you are to translate the number 5.375 into IEEE floating point notation.

First, express 5.375 as a fixed point binary number. (In fixed point binary notation, 11.11 will represent 3.75 or 3 ¾.)

Next, normalize your fixed point binary number. Show both the normalized number and the exponent. (In our 3.75 example, this would be 1.111×2^1.)

The 32-bit (single precision) IEEE format has an 8-bit exponent field, expressed in excess-127 notation, and a 23-bit fraction field. Write the bits stored in these two fields below.

__ __ __ __ __ __ __ __

__ __

Problem 5 (9 points) ECE 109 Vocabularly
Compare and contrast the following related pairs of terms.

a) Combinational logic versus sequential logic

b) nType transistor versus pType transistor

c) R-S latch versus D latch

Problem 6 (6 points) Transistors and gates

In CMOS, how many transistors are required to implement the following gates:

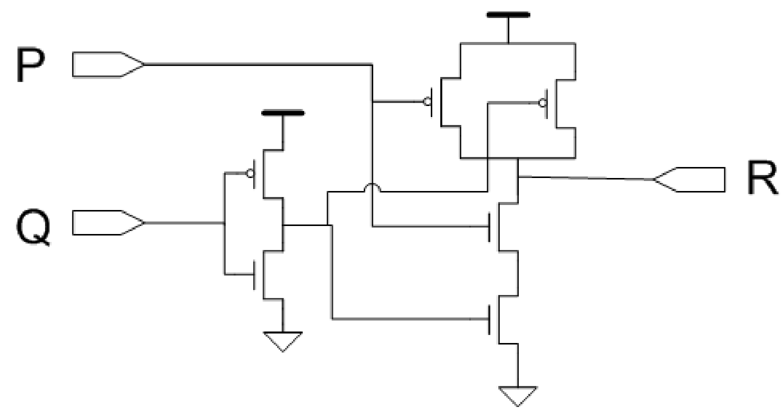
a) Invertor (NOT) gate

b) 2-input OR gate

c) 3-input NAND gate

Problem 7 (8 points) CMOS to truth table

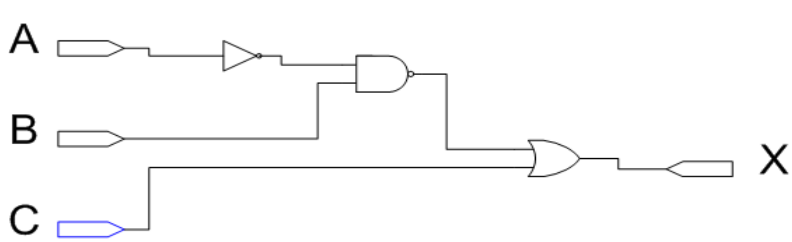
Fill in the truth table on the right to represent the CMOS circuit that is on the left.



P	Q	R
0	0	
0	1	
1	0	
1	1	

Problem 8 (12 points) Gates to truth table

Fill in the truth table on the right to represent the gate-level circuit that is on the left.

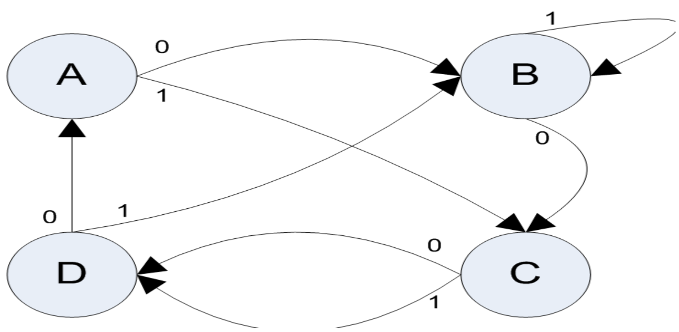


A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Problem 9 (12 points) Implementation of truth table
Draw a circuit at the gate level (no transistors) that will implement the truth table, with Z as the single output variable, shown on the right below.

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

Problem 10 (12 points) State machine to truth table
Fill in the truth table at the bottom of the page so that it represents the state machine shown on the left below. Assume that the states are represented by bits S1 and S0 as shown in the table on the right and that the single input variable is called X. Assume there is no output. (Following the conventions of the homework, the next state bits are called S1' and S0'.)



State	S1	S0
A	0	0
B	0	1
C	1	0
D	1	1

X	S1	S0	S1'	S0'
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		