ECE 331 Digital System Design

Fall 2007 Nathalia Peixoto

Student:_____
Grade: _____

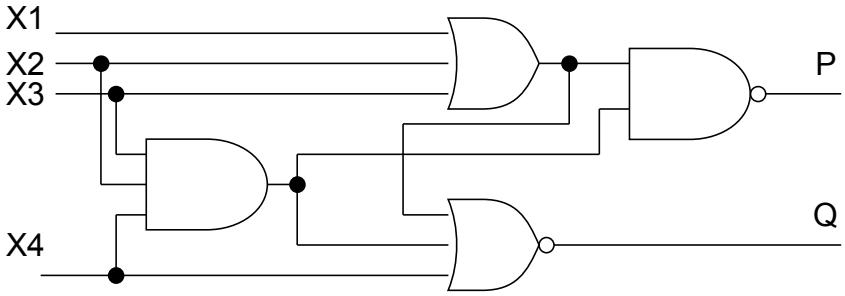
HOMEWORK 4 – due September 25th at **≤6pm**

1) Feedback (3pts) – to be completed after you finish!

- F1. If you worked on it with classmates and your solutions might be TOO similar, write their names here:_____
- F2. How long did it take you to work on the homework (don't count the reading assignment!) 2h 4h 6h 8h 10h infinite hours
- F3. Do you have suggestions on how to improve it? (ideas for new exercises?) Let us know here (and/or use your own homework sheets):

2) Logic Circuit Analysis

Using the method discussed in class, find the minimized expression for the following circuit (show all steps!). Implement this same circuit using only **NAND** gates.



3) Logic Circuit Design

The design of logic circuits entails four steps you have already mastered. Despite the fact that we haven't seen this in class, you should be able to design your first logic circuit without difficulties. Here are the steps (we will be checking that you completed those for this project):

Step 1. define inputs and outputs.

Step 2. define the truth table.

Step 3. transfer the function to a Karnaugh map and minimize it.

Step 4. implement the circuit for the minimized function.

Here are your tasks:

(a) Design a circuit to detect odd (decimal!) numbers. Assume a BCD code (binary coded decimal) with four digits ({m3,m2,m1,m0}). The MSB is m3, and the LSB is m0. You should also assume that numbers higher than 9 will never occur (treat them as "d"). Examples: if the BCD is 0010, your circuit has to output a "0", if the inputs are 0001, the output is "1".

(b) Implement the majority function for three bits (b2, b1, b0, with b0 the LSB). The majority function counts the number of "1" in any sequence, and outputs "1" if there are more 1's than 0's. Example: for 001, output will be "0", for 011, output will be "1".

4) Unsigned integer numbers, base "r" arithmetic

Give the binary result (use as many bits as you need, and consider all numbers in unsigned format) of x+y, x*y and x/y for the following x's and y's:

(show your work in binary!)

(a) x=01110010; y=11100

(b) x=0101010; y=011

5) Signed numbers, complements and addition/subtraction

For these numbers (X and Y), find their 1's and 2's complements, the result of X+Y and X-Y in 2's complement, and indicate if there is overflow. Consider all of this in 8 bits

X	Y	1's of X	1's of Y	2's of X	2's of Y	A+B (2's)	A-B (2's)	Overflow
-102	32							
-96	-37							
-96	15							
77	56							
12	-25							
-95	-47							
37	48							

6) Extra credit – please no help from TAs. If you receive help, do not submit this for grade. The idea behind the extra credit question is for you to learn on your own.

Pick three lines of exercise (4), hopefully at least one of them with overflow, and show the addition and subtraction of those numbers in 1's complement.