

CS2810 Homework 3 – 73 points - Due by midnight September 21. Submit this homework through Eagle.

For this homework assignment you may work individually or in a group of up to 3 students. If working in a group, be sure that when you turn in your homework through Eagle you include the names of everyone in the group.

Questions 1-6 (Fill in the blank) 1 point for each blank (8 points total)

- 1.) There are two kinds of digital logic circuits they are _____ logic circuits and _____ logic circuits
- 2.) Of the two types of digital logic circuits, both are the same except one has a _____ while the other does not.
- 3.) There are _____ different functions of 3 variables.
- 4.) A truth table for a 4 bit input will have _____ rows
- 5.) In the Boolean system, variables can have one of _____ values.
- 6.) AND and NOT form a _____ complete set of operators.

Question 7: 2 points each part (10 points total)

- 7.) In each case, give the decimal equivalent value of the given number. The radix or base of the number is given as a subscript, e.g. 74_8 is a base 8 value. (2 points each)
 - a. 735.5_{10}
 - b. 23.2_4
 - c. 1101101.101_2
 - d. 7521_8
 - e. $AF23_{16}$

Questions 8-12: 2 points each (10 points total)

- 8.) (True/False) A Boolean variable in a decimal system can have one of 10 different values.
- 9.) The NAND function is a logically complete Boolean function.
- 10.) The exclusive-or function is a logically complete Boolean function.
- 11.) Our decimal number system is a system whose values are in positional notation.
- 12.) Roman numerals are not a positional format notation system.

Questions 12-16: 5 points each part (45 points total)

- 13.) Give the truth table for a function with 3 inputs A,B,C and one output F(A,B,C). F is a one if exactly two of the three inputs are 1; otherwise, it is a 0.

14.) For the preceding truth table (problem 13), give the canonical sum of products Boolean expression for $F(A,B,C)$.

15.) For the preceding truth table (problem 13), give the canonical product of sums Boolean expression.

16.) Given the following Boolean expression

$$F(W,X,Y,Z) = W'X + WXY + (W + Y')(X + Y)$$

What is the Boolean expression for F'

17.) Consider the following Boolean function $F(X,Y,Z) = XY + YZ + X'Y + X'Y'Z'$.

- Without doing any minimization of the function and using only AND, OR, and NOT Gates which allow only 1-2, 1-2, and 1 input respectively, implement (draw) the circuit that represents this function.
- If each device (gate) in your circuit takes 5 ns, what is the maximum rate at which the inputs to the circuit can change?
- Using only NAND gates with up to 4 inputs, and with the minimum number of NAND gates, implement (draw) the circuit for the function $F(X,Y,Z)$.

18.) Consider a ripple carry full adder for 16-bit arithmetic. Assume that every gate in the device has a propagation delay of 1ns (that's 1×10^{-9} seconds). What is the maximum number of adds that this adder can perform per second?

19.) Using only a single 2X4 multiplexor, show how to use this multiplexor to implement the Boolean function defined in the following truth table. In other words, draw and label the multiplexor so that its output is $F()$.

A	B	C	F(A,B,C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1