Homework 2

Max marks: 106

Due on September 18, 2023, before class. Please submit both in brightspace and in person in paper this time. Grading on paper is easier.

Problem 1 *Please read Section 2.1-2.3 and Section 2.7 of Harris and Harris textbook. Write a statement to acknowledge that you have read and understood the assigned readings [1 mark].*

Problem 2 *Consider the circuit in Figure 1. Write the circuit as:*

1. *Boolean expression [5 marks]*
2. *Truth table [10 marks]*
3. *Venn diagram. [5 marks]*

(Total 20 marks)

Problem 3 *Represent the function in Figure 2 in the form of a*

1. *Venn diagram [5 marks]*
2. *Boolean expression [5 marks]*
3. *ANSI symbol network [5 marks]*
4. *Timing diagram [5 marks]*

Also, find its minimal sum-of-products form [5 marks]. (Total 25 marks).

Problem 4 *Use algebraic manipulation to simplify the function* $f = x_1x_3 + x_1x_2 + \bar{x}_1\bar{x}_2x_3 + \bar{x}_1\bar{x}_2\bar{x}_3$. *If the function is already in its simplest form, say so. [10 marks]*

Problem 5 *Use algebraic manipulation to simplify the function* $f = x_1x_2\bar{x}_3 + x_1\bar{x}_2x_4 + x_1\bar{x}_2x_3\bar{x}_4$. *If the function is already in its simplest form, say so. [10 marks]*

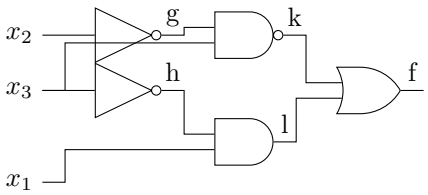

Figure 1: A three-input circuit

x_1	x_2	x_3	$f(x_1, x_2, x_3)$
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Figure 2: A three-variable function

Problem 6 *Use algebraic manipulation to prove that* $(x + y) \cdot (x + \bar{y}) = x$. *[10 marks].*

Problem 7 *Determine whether or not the following expressions are valid, i.e., whether the left- and right-hand sides represent the same function. [10 marks]*

1. $x_1\bar{x}_3 + x_2x_3 + \bar{x}_2\bar{x}_3 = (\bar{x}_1 + \bar{x}_2 + x_3)(x_1 + x_2 + \bar{x}_3)(\bar{x}_1 + x_2 + \bar{x}_3)$
2. $(x_1 + x_3)(\bar{x}_1 + \bar{x}_2 + \bar{x}_3)(\bar{x}_1 + x_2) = (x_1 + x_2)(x_2 + x_3)(\bar{x}_1 + \bar{x}_3)$

Problem 8 *Design the simplest sum-of-products circuit that implements the function* $f(x_1, x_2, x_3, x_4) = \sum m(3, 4, 6, 7, 8)$*.[10 marks]*

Problem 9 *Design the simplest product-of-sums circuit that implements the function* $f(x_1, x_2, x_3) = \prod M(0, 2, 5, 6)$*.[10 marks]*