Homework 2

Max marks: 80

Due on September 23, 2022, before class. Please submit in person in paper this time. It makes grading easier.

Problem 1 *Use algebraic manipulation to simplify the function* $f = x_1x_3 + x_1x_2 + \bar{x}_1x_2x_3 + \bar{x}_1\bar{x}_2\bar{x}_3$. *[10 marks]*

Problem 2 *Use algebraic manipulation to simplify the function* $f = x_1\bar{x}_2\bar{x}_3 + x_1\bar{x}_2x_4 + x_1\bar{x}_2x_3\bar{x}_4$.*[10 marks]*

Problem 3 *Represent the function in Figure 2 in the form of a Venn diagram and find its minimal sum-of-products form.[10 marks]*

Problem 4 *Use algebric manipulation to prove that* $(x + y) \cdot (x + \bar{y}) = x$. *[10 marks].*

Problem 5 *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 6 *Design the simplest sum-of-products circuit that implements the function* $f(x_1, x_2, x_3) = \sum m(3, 4, 6, 8)$.*[10 marks]*

Problem 7 *Design the simplest product-of-sums circuit that implements the function* $f(x_1, x_2, x_3) = \prod M(0, 2, 6)$.*[10 marks]*

References

[1] S. Brown and Z. Vranesic. *Fundamentals of Digital Logic with Verilog Design: Third Edition.* McGraw-Hill Higher Education, 2013.

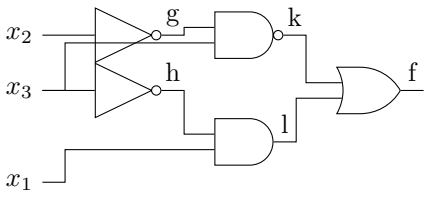

Figure 1: A three-input circuit

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