

Homework 2

Max marks: 70

Due on September 23, 2022, before class. Please submit both in brightspace and in person in paper this time. Grading on paper is 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 algebraic 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.

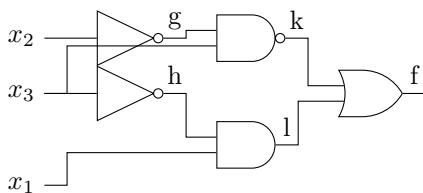


Figure 1: A three-input circuit

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