

Homework 1

Max marks: 80

Due on September 8, 2021, before class.

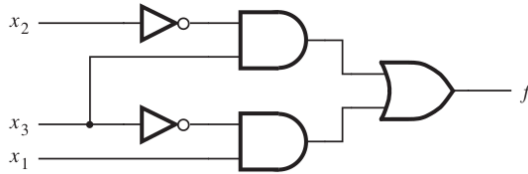


Figure 1: A three-input circuit

Row number	x_1	x_2	x_3	$f(x_1, x_2, x_3)$
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	1
7	1	1	1	0

Figure 2: A three-variable function

minimal sum-of-products form. [1, Prob 2.17][10 marks]

Problem 5 Use algebraic manipulation to prove that $(x+y) \cdot (x+\bar{y}) = x$. [1, Prob 2.2][10 marks].

Problem 6 Determine whether or not the following expressions are valid, i.e., whether the left- and right-hand sides represent the same function. [1, Prob 2.7][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 7 Design the simplest sum-of-products circuit that implements the function $f(x_1, x_2, x_3) = \sum m(3, 4, 6, 7)$. [1, Prob 2.21][10 marks]

Problem 8 Design the simplest product-of-sums circuit that implements the function $f(x_1, x_2, x_3) = \prod M(0, 2, 5)$. [1, Prob 2.22][10 marks]

Problem 1 Use algebraic manipulation to find the minimum sum-of-products expression for the function $f = x_1x_3 + x_1\bar{x}_2 + \bar{x}_1x_2x_3 + \bar{x}_1\bar{x}_2\bar{x}_3$. [1, Prob 2.12][10 marks]

Problem 2 Use algebraic manipulation to find the minimum sum-of-products expression for the function $f = x_1\bar{x}_2\bar{x}_3 + x_1x_2x_4 + x_1\bar{x}_2x_3\bar{x}_4$. [1, Prob 2.13][10 marks]

Problem 3 Draw a timing diagram for the circuit in Figure 1. Show the waveforms that can be observed on all wires in the circuit. [1, Prob 2.8][10 marks]

Problem 4 Represent the function in Figure 2 in the form of a Venn diagram and find its

References

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