

# Homework 1

Max marks: 80

Due on September 8, 2021, before class.

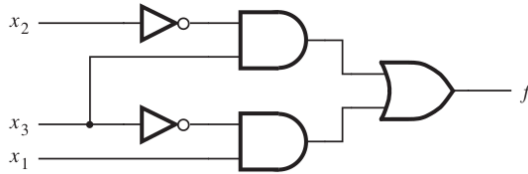


Figure 1: A three-input circuit

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