

Homework 2

Max marks: 110

Due on September 17, 2021, 9 AM, before class.

| Row | x_1 | x_2 | x_3 | f |
|-----|-------|-------|-------|-----|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 |
| 2 | 0 | 1 | 0 | 1 |
| 3 | 0 | 1 | 1 | 0 |
| 4 | 1 | 0 | 0 | 1 |
| 5 | 1 | 0 | 1 | 0 |
| 6 | 1 | 1 | 0 | 0 |
| 7 | 1 | 1 | 1 | 1 |

Table 1: Truth table for a 3-way light switch

1 Sept 10th Lecture

Problem 1 If the SOP form for $\bar{f} = A\bar{B}\bar{C} + \bar{A}\bar{B}$, then give the POS form for f . [10 marks]

Problem 2 Use DeMorgan's Theorem to find f if $\bar{f} = (A + BC)D + EF$. [10 marks]

Problem 3 Implement the function in Table 1 using only NAND gates. [10 marks]

Problem 4 Implement the function in Table 1 using only NOR gates. [10 marks]

2 Sept 13th Lecture

Problem 5 Find the minimum-cost SOP and POS forms for the function $f(x_1, x_2, x_3) = m(1, 2, 3, 5)$. [1, Prob 2.37] [10 marks]

Problem 6 Find the minimum-cost SOP and POS forms for the function $f(x_1, x_2, x_3) = \sum m(1, 4, 7) + D(2, 5)$. [1, Prob 2.38] [10 marks]

Problem 7 Find the minimum-cost SOP and POS forms for the function $f(x_1, x_2, x_3, x_4) = \prod M(0, 1, 2, 4, 5, 7, 8, 9, 10, 12, 14, 15)$. [1, Prob 2.39] [10 marks]

Problem 8 Find the minimum-cost SOP and POS forms for the function $f(x_1, x_2, x_3, x_4) = \sum m(0, 2, 8, 9, 12, 15) + D(1, 3, 6, 7)$. [1, Prob 2.40] [10 marks]

Problem 9 Derive a minimum-cost realization of the four-variable function that is equal to 1 if exactly two or exactly three of its variables are equal to 1; otherwise it is equal to 0. [1, Prob 2.46] [10 marks]

Problem 10 Find the minimum-cost SOP and POS forms for the function $f(x_1, \dots, x_5) = \sum m(0, 1, 3, 4, 6, 8, 9, 11, 13, 14, 16, 19, 20, 21, 22, 24, 25) + D(5, 7, 12, 15, 17, 23)$. [1, Prob 2.42] [10 marks]

References

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