

# Homework 3

Max marks: 100

Due on September 30, 2021, 12:00 noon, in the beginning class. Please submit in paper in class. It is easier to grade on paper. Please submit on brightspace for a digital backup, just in case.

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

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

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

**Problem 5** Find the minimum-cost SOP and POS forms for the function  $f(x_1, x_2, x_3) = m(1, 3, 4, 5)$ . Chose the minimum-cost expression by comparing POS and SOP forms. [10 marks]

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

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

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

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