

First Name: _____ Last Name: _____

30 Points

1. Simplify the following Boolean function by of a four-variable K-map in terms of minimum Sum of Products and minimum Product of Sums.

a. $F(A,B,C,D) = \sum m(0, 2, 5, 8, 9, 11, 12, 13)$

b. $F(A,B,C,D) = \sum m(0, 2, 3, 5, 7, 8, 10, 11, 14, 15)$

45 Points

2. Simplify the following Boolean functions using four variables K-maps and express your answer in minimum sum of products and minimum product of sums.

a. $F(A,B,C,D) = \sum m(0, 1, 2, 4, 5) + d(3, 6, 7)$

b. $F(X, Y, Z, W) = \prod M(0, 6, 8, 13, 14) + d(2, 4, 10)$

c. $F(A, B, C, D) = \sum m(4, 6, 7, 8, 12, 15) + d(2, 3, 5, 10, 11, 14)$

Due Date: 3/3/2023



a.

		\bar{C}	C		
\bar{A}	\bar{B}	00	01	11	10
\bar{A}	B	10	11	3	2
A	\bar{B}	4	5	7	6
A	B	12	13	15	14
A	\bar{B}	8	9	11	10
		\bar{D}	D	\bar{D}	

$$F = \sum m(0, 2, 5, 8, 9, 11, 12, 13)$$

$$F = A\bar{C} + A\bar{B}D + B\bar{C}D + \bar{A}B\bar{D}$$

		0	0	
0		0	0	
		0	0	
			0	

$$\bar{F} = BC + \bar{A}B\bar{D} + \bar{A}B\bar{D} + A\bar{C}\bar{D}$$

$$F = (\bar{B} + \bar{C})(A + B + \bar{D})(A + \bar{B} + D)(\bar{A} + \bar{C} + D)$$

b.

		\bar{C}	C
\bar{A}	\bar{B}	00	01
\bar{A}	B	10	11
A	\bar{B}	4	5
A	B	12	13
A	\bar{B}	8	9
		\bar{D}	D

$$F = \sum m(0, 2, 3, 5, 7, 8, 10, 11, 14, 15)$$

$$F = AC + \bar{B}\bar{D} + A\bar{C}D + \bar{A}BD$$

$$\bar{F} = \bar{B}\bar{C}D + ABC\bar{C} + \bar{A}B\bar{D}$$

$$F = (B + C + \bar{D})(\bar{A} + \bar{B} + C)(A + \bar{B} + D)$$

2. $F = \sum m(0, 1, 2, 4, 5) + \sum d(3, 6, 7)$

a.

\overline{A} \overline{B} \overline{C} \overline{D}

	00	01	11	10
00	1 ⁰	1 ¹	X ³	1 ²
01	1 ⁴	1 ⁵	X ⁷	X ⁶
11	1 ¹²	1 ¹³	1 ¹⁵	1 ¹⁴
10	1 ⁸	1 ⁹	1 ¹¹	1 ¹⁰

\overline{A} \overline{B} \overline{C} \overline{D}

1	1	X	1
1	1	X	X

$F = \overline{A}$
 or
 $F = 1$

both correct

b. $F(x, y, z, w) = \sum m(0, 6, 8, 13, 14) + \sum d(2, 4, 10)$

	\overline{z}	\overline{z}	\overline{z}	
	w	0	1	
x	00	1 ¹	1 ³	X ²
y	01	X ⁴	1 ⁵	0 ⁶
x	11	1 ¹²	1 ¹⁵	0 ¹⁴
y	10	0 ⁸	1 ⁹	X ¹⁰
	z	w	\overline{w}	

$F = zw + \overline{x}w + \overline{y}w$
 $+ y\overline{z}\overline{w}$

0	1	1	X
X	1	1	0
1	0	1	0
0	1	1	X

$\overline{F} = \overline{y}\overline{w} + z\overline{w} + xy\overline{z}w$
 $F = (y+w)(\overline{z}+w)(\overline{x}+\overline{y}+z+w)$



6. $F = \sum m(4, 6, 7, 8, 12, 15) + d(2, 3, 5, 10, 11, 14)$

	\bar{C}	C	
\bar{A}	00	01	11
A	00	01	11
\bar{A}	10	11	11
A	10	11	11
	\bar{D}	D	\bar{D}

The Karnaugh map shows a 4x4 grid with columns labeled \bar{C} and C , and rows labeled \bar{A} and A . The top-left cell (00) is circled in red. The top-right cell (01) is circled in green. The bottom-left cell (10) is circled in red. The bottom-right cell (11) is circled in green. The middle two rows (01 and 11) are circled in green. The middle two columns (01 and 11) are circled in green. The cells (00, 01), (10, 11), (01, 11), and (10, 11) are circled in green. The cells (00, 01), (01, 11), (10, 11), and (11, 11) are circled in green. The cells (00, 01), (01, 11), (10, 11), and (11, 11) are circled in green.

$$F = C + A\bar{D} + \begin{cases} \bar{A}B \\ \bar{A} \\ B\bar{D} \end{cases}$$

$$\bar{F} = \bar{C}D + \bar{A}B$$

$$F = (C + \bar{D})(A + B)$$