

Name: _____

Homework 2: Boolean Algebra, K-Mpas, DeMorgan's Law, Universal Gates

This assignment is to be submitted electronically via Gradescope. You must upload your answers as a PDF to Gradescope by Wednesday, 3/6/19 at 11:59pm.

1. Simplify the equations using Boolean Algebra properties. Show your work. (10 points)

1a. $F(x,y) = (\bar{x} + \bar{y}) \cdot (\bar{x} + y)$

1b. $F(A,B,C,D) = [AB \cdot (C + \overline{BC}) + A\bar{B}] \cdot \overline{CD}$

2. Convert the equations to sum-of-minterms. Show your work. (10 points)

2a. $F(x,y,z) = x + yz$

2b. $F(A,B,C) = C \cdot (B + AB)$

3. Find the simplified expression using the given the K-Maps. Note: the values in m() values are expression are where the minterms have a value of 1. (30 points)

3a. $F(A,B,C) = \Sigma m(0,4,5,6)$

	B'C'	B'C	BC	BC'
A'	0	1	3	2
A	4	5	7	6

3b. $F(A,B,C) = \Sigma m(0,1,3,5,7)$

	B'C'	B'C	BC	BC'
A'	0	1	3	2
A	4	5	7	6

3c. $F(A,B,C,D) = \Sigma m(0,2,6,7,8,10)$

	C'D'	C'D	CD	CD'
A'B'	0	1	3	2
A'B	4	5	7	6
AB	12	13	15	14
AB'	8	9	11	10

3d. $F(A,B,C,D) = \Sigma m(1,3,4,6,9,11,12,14)$

	C'D'	C'D	CD	CD'
A'B'	0	1	3	2
A'B	4	5	7	6
AB	12	13	15	14
AB'	8	9	11	10

3e. $F(A,B,C,D) = \Sigma m(1,3,5,7,9) + \Sigma d(6,12,13)$
 note: The $m()$ values are where the minterms have a value of 1. The $d()$ values are where the minterms are "don't care" conditions.

	C'D'	C'D	CD	CD'
A'B'	0	1	3	2
A'B	4	5	7	6
AB	12	13	15	14
AB'	8	9	11	10

3f. $F(A,B,C,D) = \Sigma m(0,1,3,5,9,12) + \Sigma d(2,4,6,7)$
 note: The $m()$ values are where the minterms have a value of 1. The $d()$ values are where the minterms are "don't care" conditions.

	C'D'	C'D	CD	CD'
A'B'	0	1	3	2
A'B	4	5	7	6
AB	12	13	15	14
AB'	8	9	11	10

4. Simplify the following Boolean Algebra equations using DeMorgan's Law plus other boolean properties. Show your work. Note the "single quote" means the previous value is complemented or previous group of values when the given after a closing parenthesis. (20 points)

$$4a. \quad F(A,B,C,D) = \overline{(A'B' + C'D'B')' + (ACD)'}$$

$$4b. \quad F(A) = \overline{(A' + A)'}$$

$$4c. \quad F(x,y,z) = \overline{(x' + y' + z')' \cdot (xyz' + yz)'}$$

$$4d. \quad F(x, y) = \overline{(x + y)' \cdot (x' + y)'}$$

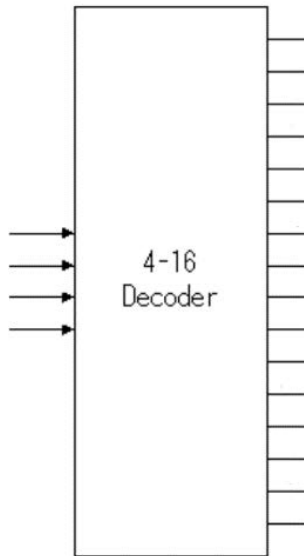
5. NAND gates and NOR gates are two types of Universal Gates. Represent each equation as a circuit using only a **single type** of a Universal Gate. I.E. Each answer must contain only NAND gates or must contain only NOR gates. (10 points)

5a. $F(x,y,z) = xz + \bar{y}z + \bar{x}yz$

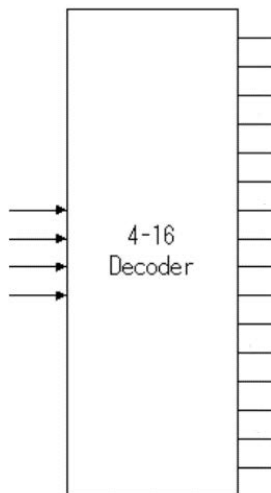
5b. $F(x,y,z) = \overline{(x + y) \cdot (y' + z) \cdot (x' + y + z)}$

6. Implement the equations from 3c and 3d using a 4-to-16 decoder and minimal other gates. Hint: only 1 other gate is needed per answer. (10 points)

6a. $F(A,B,C,D) = \sum m(0,2,6,7,8,10)$

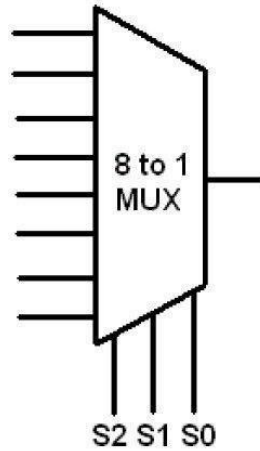


6b. $F(A,B,C,D) = \sum m(1,3,4,6,9,11,12,14)$



7. Implement the equations from 3c and 3d using an 8-to-1 multiplexor and minimal other gates. Hint: at most only 1 other gate is needed per answer. (10 points)

7a. $F(A,B,C,D) = \Sigma m(0,2,6,7,8,10)$



7b. $F(A,B,C,D) = \Sigma m(1,3,4,6,9,11,12,14)$

