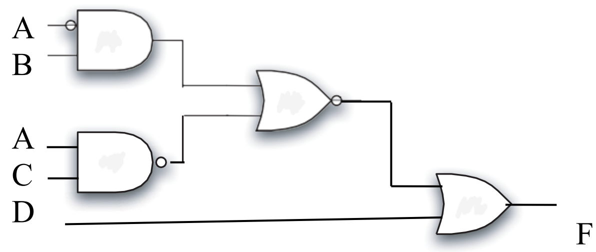
EGC-220 HW #2 Dr. Izadi

First Name: ______________________ Last Name: ___________________________

For full credit, you need to show your work neatly and box your answers.

1. (10 PT.) Using AND, OR, and NOT gates, draw the logic diagrams for the following Boolean expressions without expanding or simplifying them.
    a. Y = (A'+B')C + B(A+C)
    b. W= (A+B')(C+D')

2. (10 PT.) Write the Boolean expression equivalent to the following logic circuit. Do not simplify!



3. (10 PT.) Write a truth table for

$$F(A, B, C) = (\overline{A + B})(B + \overline{C})$$

4. (10 PT.) Find the dual of
    a. F = A'B + B'C' + D'
    b. $F(A, B, C) = (\overline{A + B})(B + \overline{C})$

5. (10 PT.) Find the complement of
    a. F = A'B + B'C' + D'
    b. $F(A, B, C) = (\overline{A + B})(B + \overline{C})$

6. (10 PT.) Demonstrate by means of truth tables the validity of the following identities
    A. DeMorgan's law for three variables: (X+Y+Z)' = X'Y'Z' and (XYZ)' = X' + Y' + Z'
    B. (X+Y) X = X

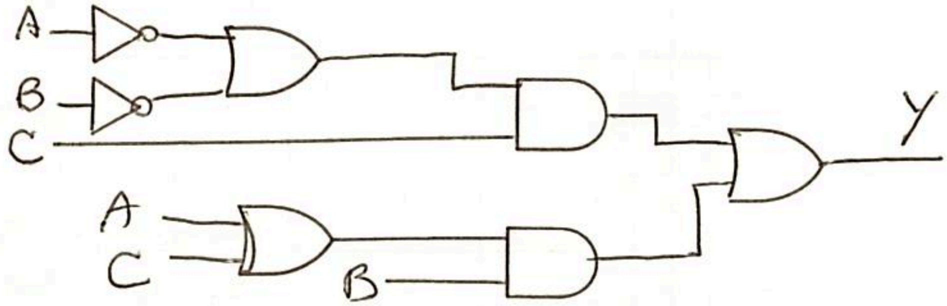
7. (25 PT.) Simplify the following Boolean expression as much as possible.
    a. ABC + A'B +ABC'
    b. (X+Y)'(X'+Y')
    c. (BC' + A'D)(AB' + CD')
    d. X'YZ + XZ
    e. XY + X(WZ +WZ')

8. (15 PT.) Reduce the following Boolean expression to the indicated number of literals:

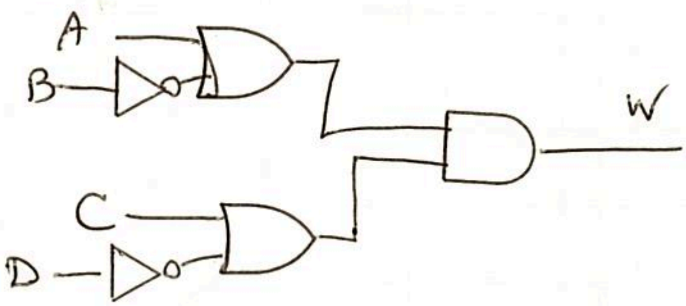
a.	A'C' + ABC + AC'	to three literals
b.	(A' + C)(A'+ C')(A + B + C'D)	to four literals
c.	A'B(D'+C'D) + B(A + A'CD)	to one literal

Due Date: 2/24/2023

1. a. $Y=(\bar{A}+\bar{B})C+B(A+C)$



b. $W=(A+\bar{B})(C+\bar{D})$



2. $F=\overline{(\bar{A}B+\overline{AC})}+D$

3. $F=(\overline{A+B})(B+\bar{C})$

$=\bar{A}\cancel{\bar{B}}B+\bar{A}\bar{B}\bar{C}$

A	B	C	F
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

4.

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

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

b. $F = (\overline{A+B})(B+\bar{C})$

$$F_D = (\overline{AB}) + B\bar{C}$$

5.

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

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

b. $F = \overline{(\overline{A+B})(B+\bar{C})}$

$$= \overline{\overline{A+B}} + \overline{B+\bar{C}}$$

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

6.

a/

X	Y	Z	X+Y+Z	(X+Y+Z)'	X'Y'Z'	XYZ	(XYZ)'	X'+Y'+Z'
0	0	0	0	1	1	0	1	1
0	0	1	1	0	0	0	1	1
0	1	0	1	0	0	0	1	1
0	1	1	1	0	0	0	1	1
1	0	0	1	0	0	0	1	1
1	0	1	1	0	0	0	1	1
1	1	0	1	0	0	0	1	1
1	1	1	1	0	0	1	0	0

match　　　match

b/

X	Y	X+Y	X(X+Y)
0	0	0	0
0	1	1	0
1	0	1	1
1	1	1	1

match

7.

a. $AB C + \bar{A} B + A B \bar{C}$

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

$= AB + \bar{A}B$

$= B(A+\bar{A})$

$= B$

b.

$$\overline{(X+Y)}\,(\bar{X}+\bar{Y})$$

$$\bar{X}\,\bar{Y}\,(\bar{X}+\bar{Y})$$

$$=\bar{X}\,\bar{Y}+\bar{X}\,\bar{Y}$$

$$=\bar{X}\,\bar{Y}$$

c.

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

$$=\underbrace{A\bar{B}\cancel{B}\bar{C}}_{0}+\underbrace{\bar{A}\cancel{A}\bar{B}D}_{0}+\underbrace{B\cancel{\bar{C}}C\bar{D}}_{0}+\underbrace{\bar{A}\cancel{C}D\bar{D}}_{0}$$

$$=0$$

d.

$$\bar{X}YZ+XZ$$

$$=Z(\bar{X}Y+X)$$

$$=Z(\bar{X}+X)(Y+X)$$

$$=Z(Y+X)$$

$$=XZ+YZ$$

e.

$$XY+X(\underbrace{WZ+WZ'}_{W})$$

$$=XY+XW$$

8.

8.a

$$\bar{A}\bar{C} + ABC + A\bar{C}$$

$$= \bar{C}(\bar{A} + A) + ABC$$

$$= \bar{C} + ABC$$

$$= (\bar{C} + C)(\bar{C} + ABC) \quad = \bar{C}\bar{C} + \cancel{C\bar{C}}_{0} + \cancel{ABC\bar{C}}_{0} + ABC$$

$$= \bar{C} + ABC$$

$$= \bar{C} + ABC$$

8.b.

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

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

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

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

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

8.c

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

$$= \bar{A}B(\underbrace{\bar{D} + D}_{1})(\bar{D} + \bar{C}) + B(\underbrace{A + \bar{A}}_{1})(A + CD)$$

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

$$= \bar{A}B\bar{D} + \bar{A}\bar{C}B + AB + BCD$$

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

$$= B\underbrace{(A+\bar{A})}_{1}(A+\bar{D}) + \bar{A}\bar{C}B + BCD$$

$$= AB + B\bar{D} + \bar{A}\bar{C}B + BCD$$

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

$$= B\underbrace{(A+\bar{A})}_{1}(A+\bar{C}) + B\underbrace{(\bar{D}+D)}_{1}(\bar{D}+C)$$

$$= AB + B\bar{C} + B\bar{D} + BC$$

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

$$= AB + B + B\bar{D}$$

$$= B(\underbrace{A + 1 + \bar{D}}_{1})$$

$$= B.$$

4.

$$F = X + YZ$$

$$\bar{F} = \overline{X + YZ}$$

$$= \bar{X}(\overline{YZ})$$

$$= \bar{X}(\bar{Y} + \bar{Z})$$

$$F = XY + \bar{Z}$$

$$\bar{F} = (\bar{X}+\bar{Y})Z$$

$$F \cdot \bar{F} = (XY + \bar{Z})(\bar{X}+\bar{Y})Z$$

$$= (XYZ + \cancel{Z\bar{Z}})(\bar{X}+\bar{Y})$$

$$= \bar{X}\cancel{X}YZ + \bar{Y}X\cancel{Y}Z$$

$$= 0$$