

2-1, 4, 7, 9, 11, 13, 14, 18

ITE 1100 A Assignment #2

1a) DeMorgan's Theorem: $(x+y+z)' = x'y'z'$

x	y	z	$(x+y+z)'$	$x'y'z'$
0	0	0	1	1
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	0	0
1	1	1	0	0

∴ Valid

$$\underline{(xyz)' = x' + y' + z'}$$

x	y	z	$(xyz)'$	$x' + y' + z'$
0	0	0	1	1
0	0	1	1	1
0	1	0	1	1
0	1	1	1	1
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

∴ Valid

b) $x+yz = (x+y)(x+z)$

x	y	z	$x+yz$	$(x+y)$	$(x+z)$	$(x+y)(x+z)$
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	1	1	1	1
1	0	0	1	1	1	1
1	0	1	1	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

∴ Valid

c) $x(y+z) = xy + xz$

x	y	z	$x(y+z)$	xy	xz	$xy+xz$
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	0	0	0	0
1	0	0	0	0	0	0
1	0	1	1	0	1	1
1	1	0	1	1	0	1
1	1	1	1	1	1	1

$\therefore$ valid.

d) $x + (y+z) = (x+y) + z$

x	y	z	$x + (y+z)$	$(x+y) + z$
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	1
1	0	0	1	1
1	0	1	1	0
1	1	0	1	1
1	1	1	1	1

$\therefore$ valid

e) $x(yz) = (xy)z$

x	y	z	$x(yz)$	$(xy)z$
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

$\therefore$ Valid

$$\begin{aligned}
 4a) \quad & A'C' + ABC + AC' \\
 & C'(A' + A) + ABC \\
 & C' + ABC \\
 & C'(1 + AB) + ABC \\
 & C' + ABC' + ABC \\
 & C' + AB(C' + C) \\
 & C' + AB
 \end{aligned}$$

$$\begin{aligned}
 c) \quad & A'B(D' + C'D) + B(A + A'CO) \\
 & A'BD' + A'BC'D + AB + A'BCD \\
 & A'BD' + A'BD(C' + C) + AB \\
 & A'B(D' + D) + AB \\
 & B(A' + A) \\
 & B
 \end{aligned}$$

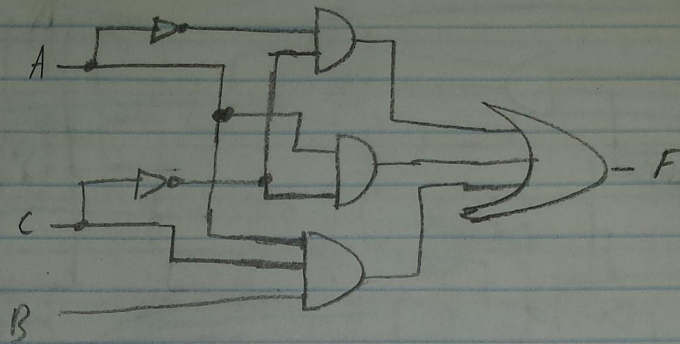
$$\begin{aligned}
 d) \quad & (A' + C)(A' + C')(A + B + C'D) \\
 & (A' + (CC'))(A + B + C'D) \\
 & (A' + 0)(A + B + C'D) \\
 & A'(A + B + C'D) \\
 & A'A + A'B + A'C'D \\
 & A'B + A'C'D
 \end{aligned}$$

$$\begin{aligned}
 e) \quad & ABC'D + A'BD + ABCD \\
 & ABD(C' + C) + A'BD \\
 & ABD + A'BD \\
 & BD(A + A') \\
 & BD
 \end{aligned}$$

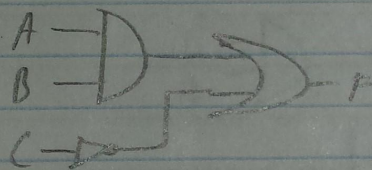
$$\begin{aligned}
 b) \quad & (x'y' + z)' + z + xy + wz \\
 & (x'y')'z' + z + xy + wz \\
 & (x + y)z' + z + xy + wz \\
 & xz' + yz' + z + xy + wz \\
 & xz' + yz' + z(1 + w) + xy \\
 & xz' + yz' + z + xy \\
 & xz' + yz' + z(x + y + 1) + xy \\
 & xz' + yz' + zx + zy + z + xy \\
 & x(z' + z) + y(z' + z) + z + xy \\
 & x + y + z + xy \\
 & x(1 + y) + y + z \\
 & x + y + z
 \end{aligned}$$

2a) $F = A'C' + ABC + AC'$

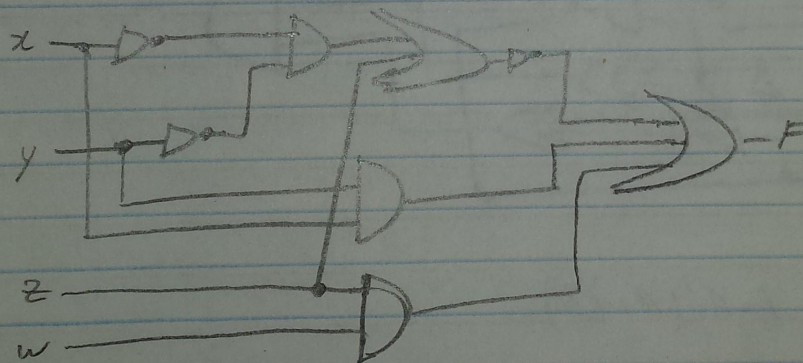
Original:



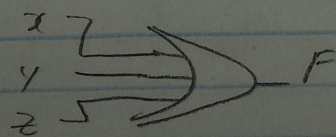
Simplified: $F = AB + C'$



b) $F = (x'y' + z)' + x + xy + wz$

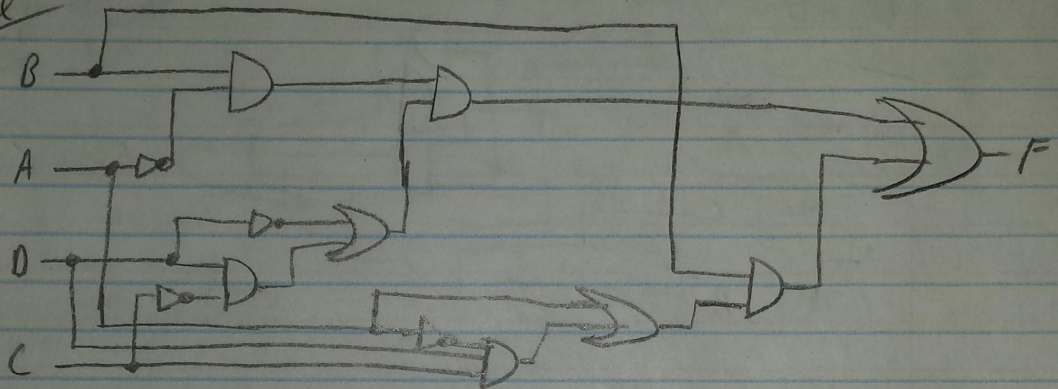


Simplified: $F = x + y + z$



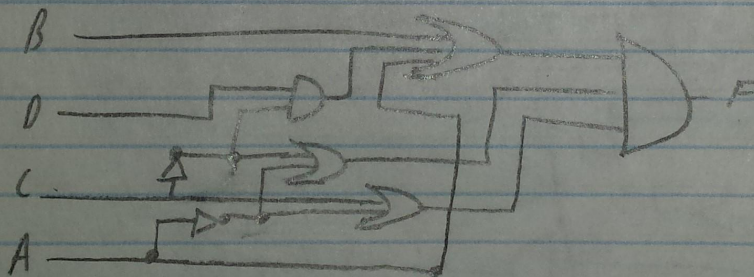
c) $F = A'B(D' + C'D) + B(A + A'CO)$

Original

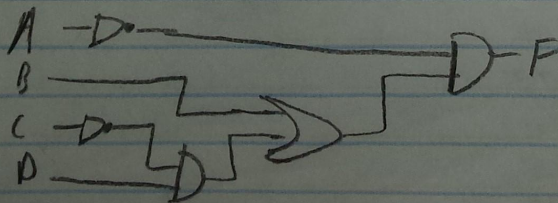


Simplified: $F = B$
 $B \rightarrow F$

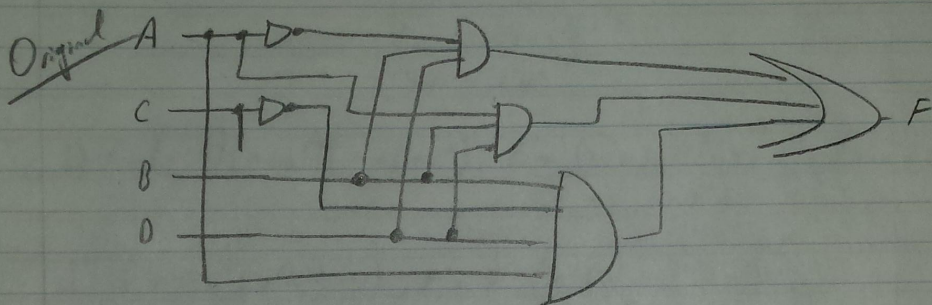
d) $F = (A'C)(A' + C')(A + B + C'D)$



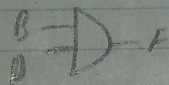
Simplified: $F = A'(B + C'D)$



7c) $F = ABC'D + A'BD + ABCD$



Simplified $F = BD$



$$\begin{aligned}
 9a) \quad F &= xy' + x'y, \quad F' = ((xy') + (x'y))' \\
 &= (xy')' (x'y)' \\
 &= (x' + y)(x + y') \\
 &= xy + x'y'
 \end{aligned}$$

$$\begin{aligned}
 b) \quad F &= (a+b)(a+b')(a'+b+c'), \quad F' = (a+c)' + (a+b')' + (a'+b+c')' \\
 &= a'c' + a'b + a'b'c
 \end{aligned}$$

$$\begin{aligned}
 c) \quad F &= z + z'(v'w + xy), \quad F' = z' (z' (v'w + xy))' \\
 &= z' (z' + (v'w + xy)') \\
 &= z' (z' + (v'w)' (xy)') \\
 &= z' (z' + (v'w)(x' + y')) \\
 &= z'z + z'(v'w)(x' + y') \\
 &= z(v'w)(x' + y')
 \end{aligned}$$

$$11a) \quad F = xy + xy' + y'z$$

$$b) \quad F = bc + a'c'$$

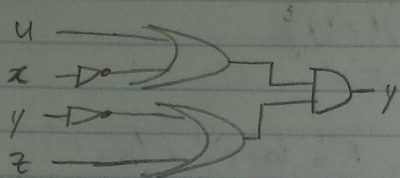
x	y	z	F
0	0	0	0 m_0
0	0	1	1 m_1
0	1	0	0 m_2
0	1	1	0 m_3
1	0	0	1 m_4
1	0	1	1 m_5
1	1	0	1 m_6
1	1	1	1 m_7

a	b	c	F
0	0	0	1 m_0
0	0	1	0 m_1
0	1	0	1 m_2
0	1	1	1 m_3
1	0	0	0 m_4
1	0	1	0 m_5
1	1	0	0 m_6
1	1	1	1 m_7

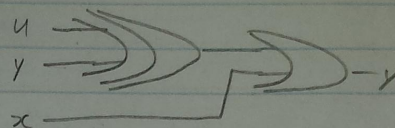
$$F(x, y, z) = \sum m(1, 4, 5, 6, 7)$$

$$F(a, b, c) = \sum m(0, 2, 3, 7)$$

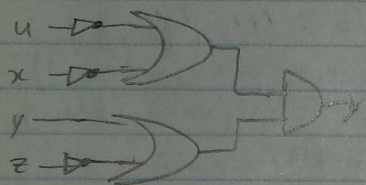
$$13a) y = [(u+x')(y'+z)]$$



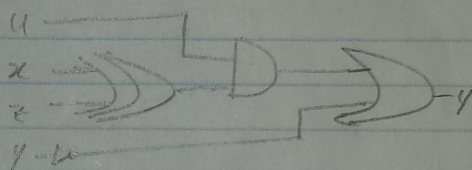
$$b) y' = (u \oplus y)' + x$$



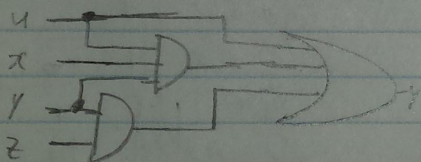
$$c) y = (u'+x')(y+z')$$



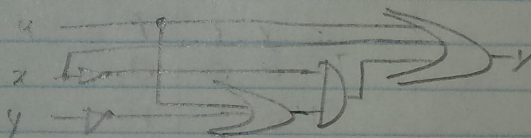
$$d) y = u(x \oplus z) + y'$$



$$e) y = u + yz + uxy$$

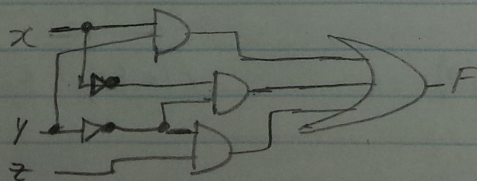


$$f) y = u + x + x'(u + y')$$



$$14) F = (xy + x'y' + y'z)$$

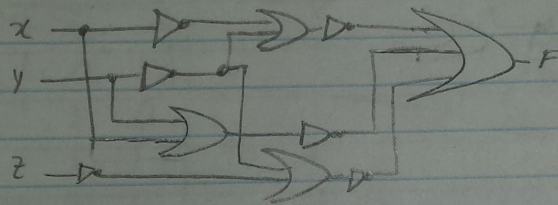
a) 1 AND, OR, inverters.



146) w/ OR and inverter gates.

$$xy = (x' + y')'; \quad x'y' = (x + y)'; \quad y'z = (y + z')$$

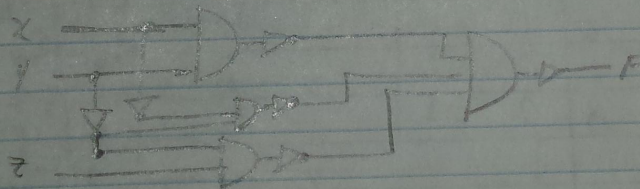
$$F = (x' + y')' + (x + y)' + (y + z')$$



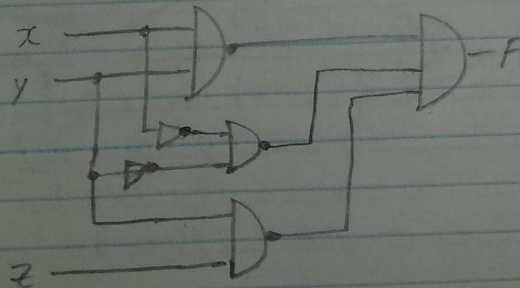
c) w/ AND and inverters

$$F' = (xy + x'y' + y'z)' = (xy)'(x'y')'(y'z)'$$

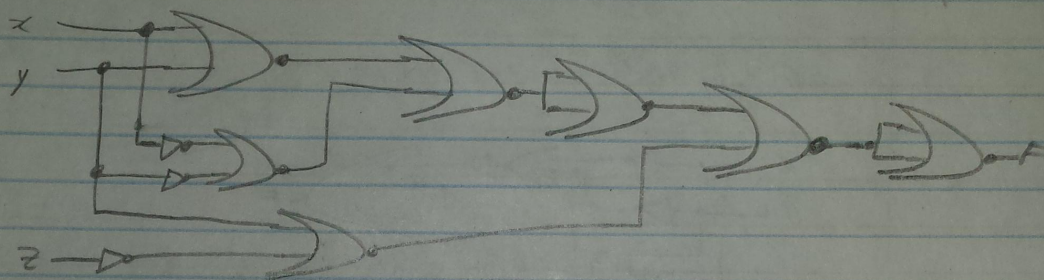
$$F'' = F[(xy)'(x'y')'(y'z)']'$$



a) w/ NAND and inverters (same as c).

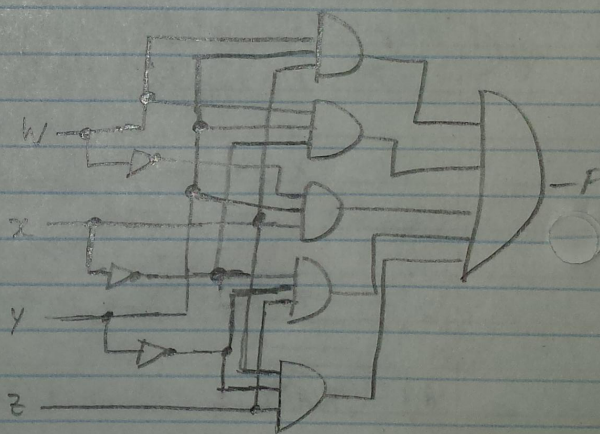


e) w/ NOR and inverter gates. (same F as (b))



18a) $F = xy'z + x'y'z + w'xy + wx'y + wxz$

w	x	y	z	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1



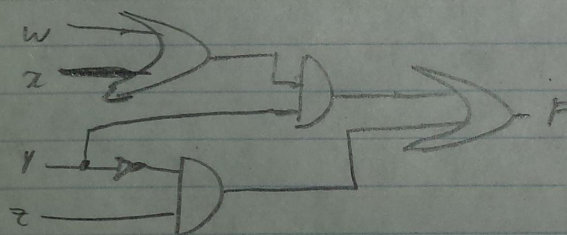
$$\begin{aligned}
 c) F &= xy'z + x'y'z + w'xy + wx'y + wxz \\
 &= [x(y'z) + x'(y'z)] + [xy(w' + w)] + wxz \\
 &= y'z + xy + wx'y \\
 &= y'z + y(x + x'w) \\
 &= y'z + y(x + w)
 \end{aligned}$$

18d)

w	x	y	z	$y'z + y(x+w)$	F
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	0	0
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	1	1
1	0	0	0	0	0
1	0	0	1	1	1
1	0	1	0	1	1
1	0	1	1	1	1
1	1	0	0	0	0
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1

is equal

d) $F = y'z + y(x+w)$



Part

b) 9 gates

c) 5 gates.