ITI1100B&C

Professor: Qi Hao

Assignment # 2

Submission Deadline Feb. 8th, 2017 midnight (11h59 PM), BlackBoard Learn

From the textbook Chapter 2 pages 69-71, solve the following problems

2.1(a)(b)(e), 2.4, 2.7(a)(b)(c)(d), 2.9, 2.11, 2.13(a)(b)(c)(d)(e), 2.14, 2.15, 2.17(b), 2.18.

2.1 **(a)**

Total 3 points

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

(b)

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

(e)

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

2.4 **(a)** $A'C' + ABC + AC' = C' + ABC = (C + C')(C' + AB) = AB + C'$

Total 5 points

(b) $(x'y' + z)' + z + xy + wz = (x'y')'z' + z + xy + wz = [(x + y)z' + z] + xy + wz =$
$= (z + z')(z + x + y) + xy + wz = z + wz + x + xy + y = z(1 + w) + x(1 + y) + y = x + y + z$

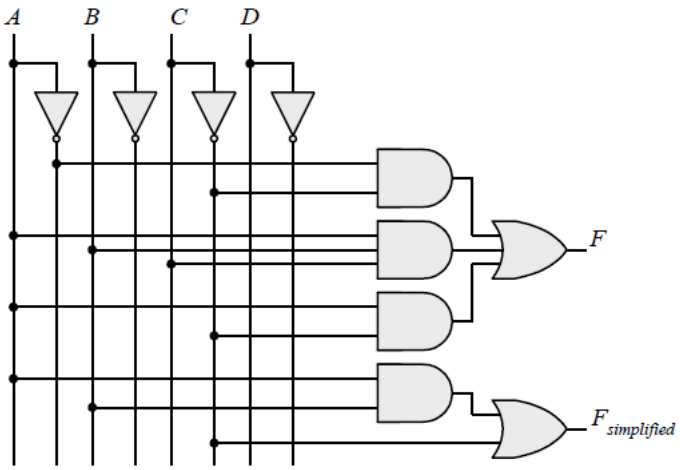
(c) $A'B(D' + C'D) + B(A + A'CD) = B(A'D' + A'C'D + A + A'CD)$
$= B(A'D' + A + A'D(C + C') = B(A + A'(D' + D)) = B(A + A') = B$

(d) $(A' + C)(A' + C')(A + B + C'D) = (A' + CC')(A + B + C'D) = A'(A + B + C'D)$
$= AA' + A'B + A'C'D = A'(B + C'D)$

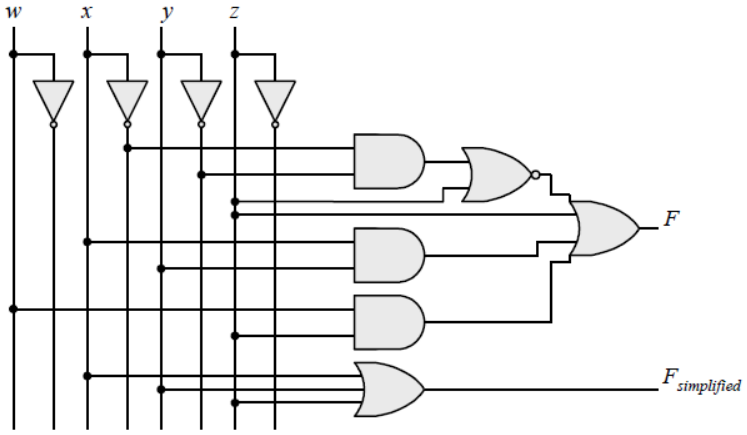
(e) $ABC'D + A'BD + ABCD = AB(C + C')D + A'BD = ABD + A'BD = BD$

2.7 **(a)**

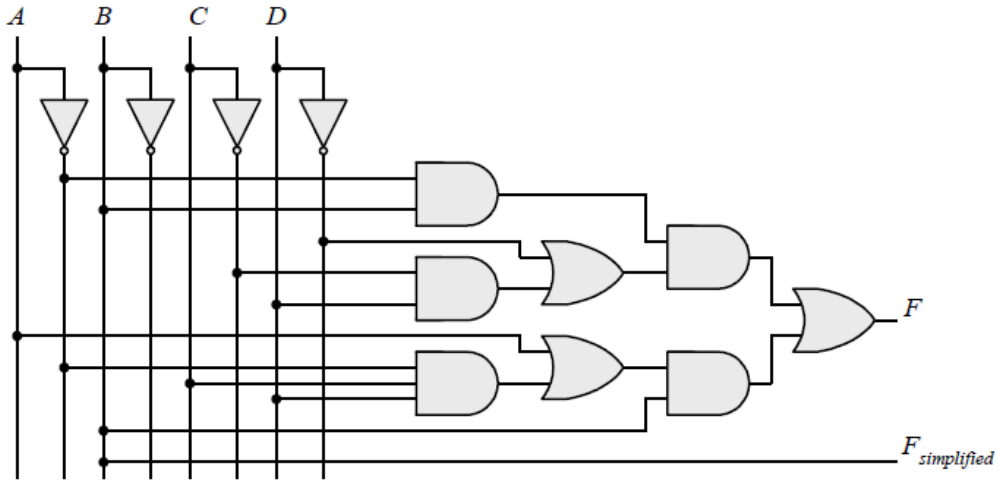
Total 6 points



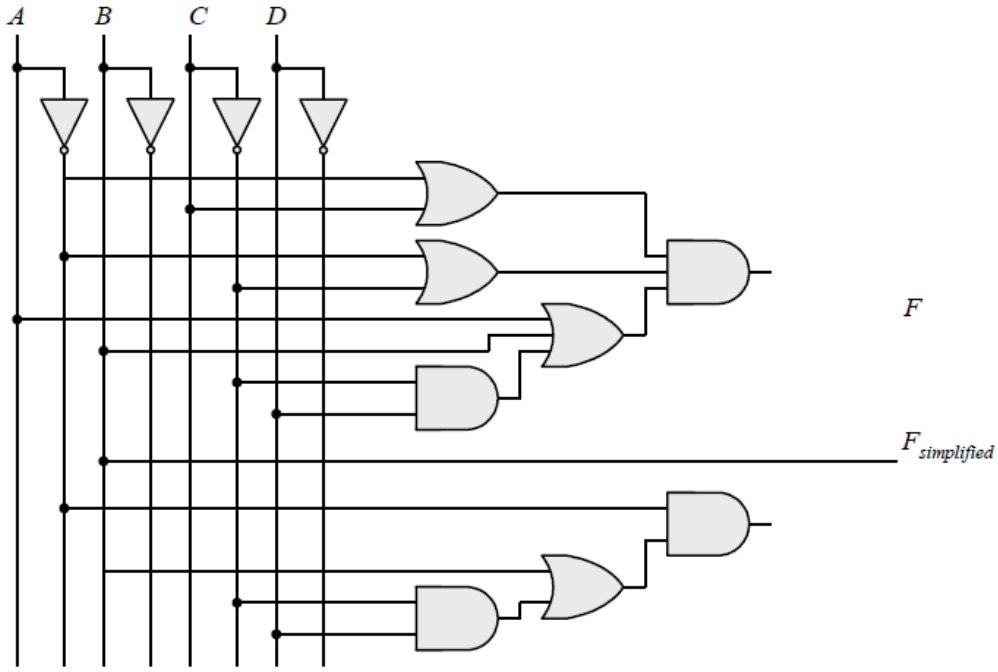
(b)



(c)



(d)



2.9

Total
3 points

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

(b) $F' = [(a + c)(a + b')(a' + b + c')]' = (a + c)' + (a + b')' + (a' + b + c')'$
$= a'c' + a'b + ab'c$

(c) $F' = [z + z'(v'w + xy)]' = z'[z'(v'w + xy)]' = z'[z'v'w + xyz']'$
$= z'[(z'v'w)'(xyz')'] = z'[(z + v + w') + (x' + y' + z)]$
$= z'z + z'v + z'w' + z'x' + z'y' + z'z = z'(v + w' + x' + y')$

(c) Error. Correction:

$$(z + z'(v'w + xy) = z'[z'(v'w + xy)]' = z'[z'v'w + xyz']' =$$
$$z'((z'v'w)'(xyz')') = z'\big((z + v + w')(x' + y' + z)\big) =$$
$$z'(z + (v + w')(x' + y') = z'(v + w')(x' + y')$$

2.11

Total
2 points

(a) $F(x, y, z) = \Sigma(1, 4, 5, 6, 7)$

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

$F = xy + xy' + y'z$

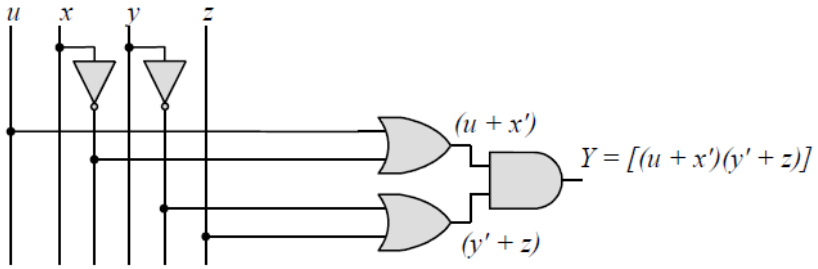
x y z	F
0 0 0	0
0 0 1	1
0 1 0	0
0 1 1	0
1 0 0	1
1 0 1	1
1 1 0	1
1 1 1	1

$F = bc + a'c'$

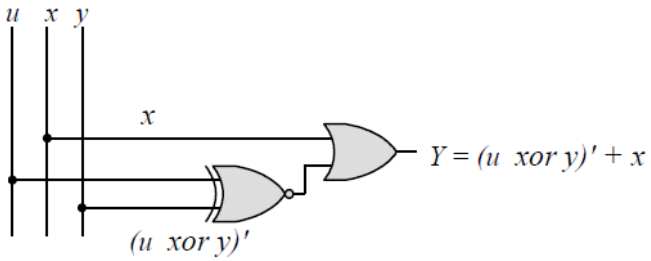
a b c	F
0 0 0	1
0 0 1	0
0 1 0	1
0 1 1	1
1 0 0	0
1 0 1	0
1 1 0	0
1 1 1	1

2.13 **(a)**

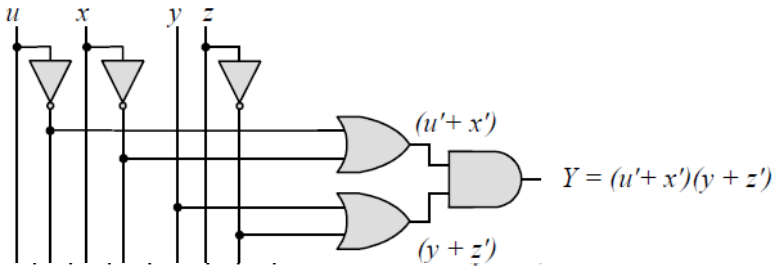
Total
5 points



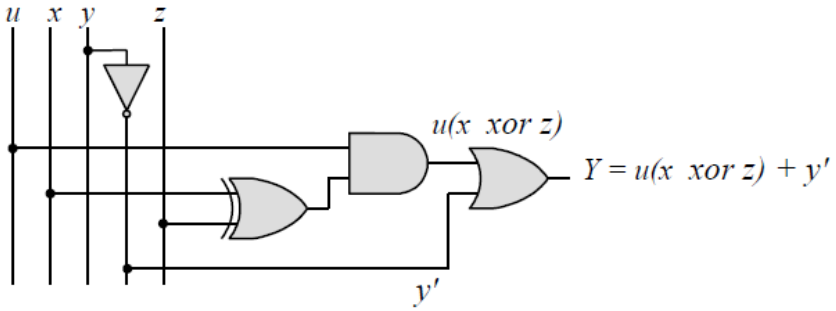
(b)



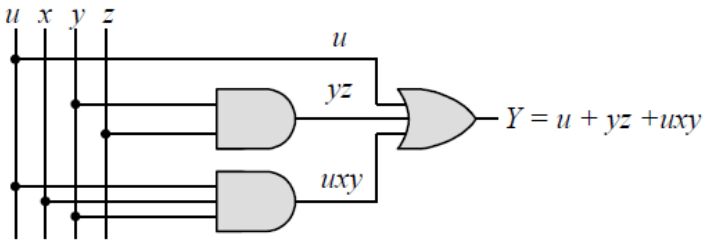
(c)



(d)

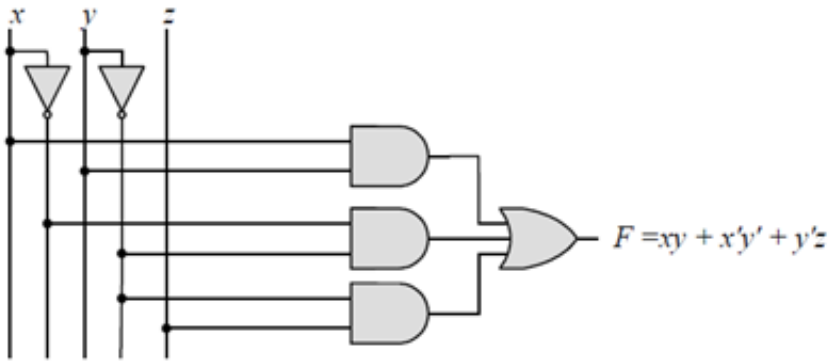


(e)

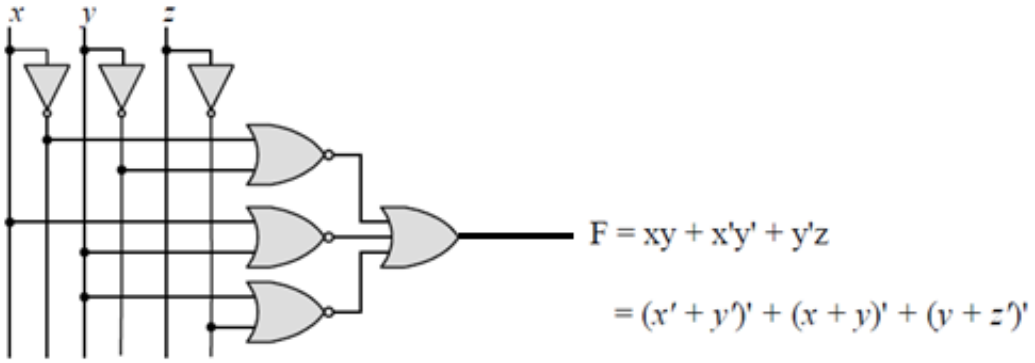


2.14 **(a)**

Total
6.5 points

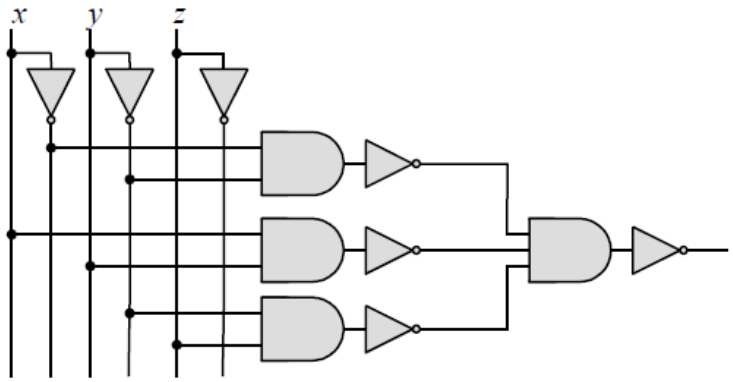


(b)



Correction for (b): NOR gate should be replaced by an OR gate plus an inverter gate.

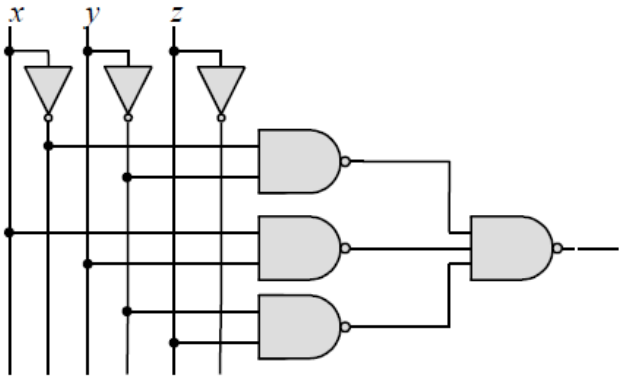
(c)



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

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

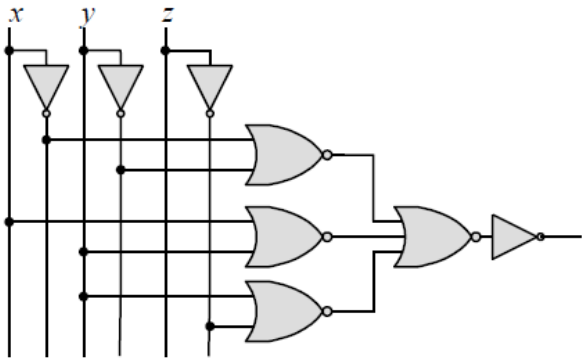
(d)



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

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

(e)



F = xy + x'y' + y'z

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

2.15 **(a)** $T_1 = A'B'C' + A'B'C + A'BC' = A'B'(C' + C) + A'C'(B' + B) = A'B' + A'C' = A'(B' + C')$

Total 3 points

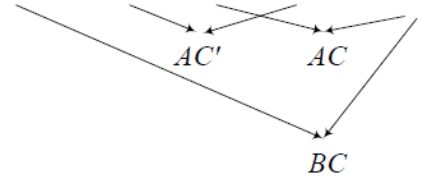
(b) $T_2 = T_1' = A'BC + AB'C' + AB'C + ABC' + ABC$
$= BC(A' + A) + AB'(C' + C) + AB(C' + C)$
$= BC + AB' + AB = BC + A(B' + B) = A + BC$

$\sum(3, 5, 6, 7) = \prod(0, 1, 2, 4)$

$T_1 = A'B'C' + A'B'C + A'BC'$

$T_1 = A'B' \ A'C' = A'(B' + C')$

$T_2 = A'BC + AB'C' + AB'C + ABC' + ABC$



$T_2 = AC' + BC + AC = A + BC$

2.17 **(b)** $(cd + b'c + bd')(b + d) = bcd + bd' + cd + b'cd = cd + bd'$
$= \Sigma\,(3, 4, 7, 11, 12, 14, 15)$
$= \Pi\,(0, 1, 2, 5, 6, 8, 9, 10, 13)$

Total 1.5 points

a b c d	F
0 0 0 0	0
0 0 0 1	0
0 0 1 0	0
0 0 1 1	1
0 1 0 0	1
0 1 0 1	0
0 1 1 0	0
0 1 1 1	1
1 0 0 0	0
1 0 0 1	0
1 0 1 0	0
1 0 1 1	1
1 1 0 0	1
1 1 0 1	0
1 1 1 0	1
1 1 1 1	1

2.18 (a)

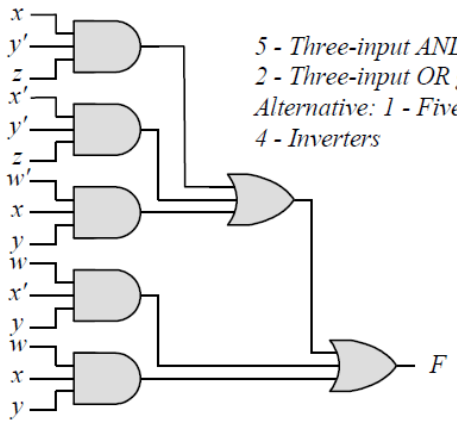
Total
5 points

wx y z	F
00 0 0	0
00 0 1	1
00 1 0	0
00 1 1	0
01 0 0	0
01 0 1	1
01 1 0	1
01 1 1	1
10 0 0	0
10 0 1	1
10 1 0	1
10 1 1	1
11 0 0	0
11 0 1	1
11 1 0	1
11 1 1	1

$F = xy'z + x'y'z + w'xy + wx'y + wxy$

$F = \Sigma(1, 5, 6, 7, 9, 10\ 11, 13, 14, 15)$

(b)

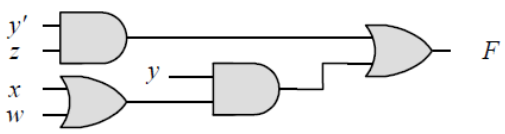


5 - Three-input AND gates
2 - Three-input OR gates
Alternative: 1 - Five-input OR gate
4 - Inverters

(c) $F = xy'z + x'y'z + w'xy + wx'y + wxy = y'z + xy + wy = y'z + y(w + x)$

(d) $F = y'z + yw + yx) = \Sigma(1, 5, 9, 13\ , 10, 11, 13, 15, 6, 7, 14, 15)$
$= \Sigma(1, 5, 6, 7, 9,\ 10, 11, 13, 14, 15)$

(e)



1 – Inverter, 2 – Two-input AND gates, 2 – Two-input OR gates