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EE 101 TTh lecture
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Due Thursday, Feburary 13, 2014
Homework #2

1.
a.

ABC	A'	B'	$A'+B'$	C	F
000	1	1	1	0	0
001	1	1	1	1	1
010	1	0	1	0	0
011	1	0	1	1	1
100	0	1	1	0	0
101	0	1	1	1	1
110	0	0	0	0	0
111	0	0	0	1	0

$F = A'B'C + A'BC + AB'C = m_1 + m_3 + m_5 = \sum_{ABC}(1,3,5)$

b.

WXY	W'	X'	Y'	WX'	XY'	G
000	1	1	1	0	0	1
001	1	1	0	0	0	1
010	1	0	1	0	1	1
011	1	0	0	0	0	1
100	0	1	1	1	0	1
101	0	1	0	1	0	1
110	0	0	1	0	1	1
111	0	0	0	0	0	1

$G = W' + X' + Y' = M_7 = \prod_{WXY}(7)$

2.

$$\begin{aligned}
G = &\sum_{ABCD}(0,2,4,6,13,15)\\
=&A'B'C'D' + A'B'CD' + A'BC'D' + A'BCD' + ABC'D + ABCD\\
=&\prod_{ABCD}(1,3,5,7,8,9,10,11,12,14)\\
=&(A+B+C+D')(A+B+C'+D')(A+B'+C+D')(A+B'+C'+D')\\
&(A'+B+C+D)(A'+B+C+D')(A'+B+C'+D)(A'+B+C'+D')\\
&(A'+B'+C+D)(A'+B'+C'+D)
\end{aligned}$$

4. a.

$$\begin{aligned}F &= X + [(W'Y'Z)(W + (X'(Y + Z)))] \\ &= X + [W'Y'Z(W + X'Y + X'Z)] \\ &= X + [WW'Y'Z + W'X'YY'Z + W'X'Y'ZZ] \\ &= X + [0 + 0 + W'X'Y'Z] \\ &= (X + W')(X + X')(X + Y')(X + Z) \\ &= (X + W')(X + Y')(X + Z)\end{aligned}$$

b.

$$\begin{aligned}G &= AB + D(B' + C)(A' + C) \\ &= AB + D(A'B' + A'C + B'C + CC) \\ &= AB + D(A'B' + A'C + B'C + C) \\ &= AB + D(A'B' + C(A' + B' + 1)) \\ &= AB + D(A'B' + C) \\ &= AB + A'B'D + CD\end{aligned}$$

5.

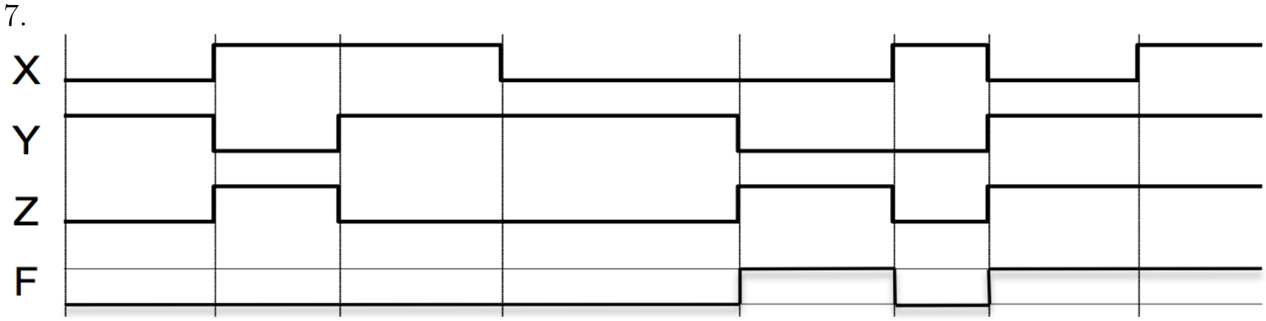
$$\begin{aligned}J &= P + R'S \\ &= (PRS + PR'S + PRS' + PR'S') + (PR'S + P'R'S) \\ &= PRS + PR'S + PRS' + PR'S' + P'R'S \\ &= m_7 + m_5 + m_6 + m_4 + m_1 \\ &= \sum_{WYZ}(1, 4, 5, 6, 7)\end{aligned}$$

6.

a. The faulty OR gate always outputs 1 even if it is supposed to output 0 and let H output 0, per the special input we give, which is the mechanism we use to identify the faulty OR gate. For the top gate, the combined input is `011`. For the middle gate, the combined input is `101`. For the bottom gate, the combined input is `010`.

b. No. In this case the final output (H) would always output 0 because it is an AND gate and always receives a 0 input from the faulty gate. No combination of input can make H change, thus we can't identify the faulty gate.

7.



8.

a.

$$\begin{aligned} G &= (A'(BC)' + (A' + B'))' \\ &= (A'(BC)')'(A' + B')' \\ &= (A + BC)(AB) \\ &= AAB + ABBC \\ &= AB + ABC \\ &= AB(1 + C) \\ &= AB \end{aligned}$$

b. $G = AB = \sum_{AB}(3) = AB(C + C') = ABC + ABC' = \sum_{ABC}(6, 7)$

9.

a.

C/AB	00	01	11	10
0	$^{0}1$	$^{2}1$	^{6}	$^{4}1$
1	^{1}	^{3}	$^{7}1$	^{5}

SOP= $A'C' + B'C' + ABC$

C/AB	00	01	11	10
0	^{0}	^{2}	$^{6}0$	^{4}
1	$^{1}0$	$^{3}0$	^{7}	$^{5}0$

POS= $(A + C')(B + C')(A' + B' + C)$

b.

YZ/WX	00	01	11	10
00	$^{0}1$	$^{4}1$	^{12}	^{8}
01	$^{1}1$	$^{5}1$	$^{13}1$	$^{9}1$
11	^{4}	^{7}	^{15}	^{11}
10	^{2}	$^{6}1$	^{14}	$^{10}1$

SOP= $W'Y' + Y'Z + W'XZ' + WX'YZ'$

YZ/WX	00	01	11	10
00	^{0}	^{4}	$^{12}0$	$^{8}0$
01	^{1}	^{5}	^{13}	^{9}
11	$^{4}0$	$^{7}0$	$^{15}0$	$^{11}0$
10	$^{2}0$	^{6}	$^{14}0$	^{10}

POS= $(Y' + Z')(W + X + Y')(W' + X' + Y')(W' + Y + Z)$

10.

Note that $A \oplus B = A'B + AB' = AA' + AB' + A'B + BB' = (A + B)(A' + B') = (A + B)(AB)'$, the result of the revised circuit,

$$\begin{aligned} Y &= [([(A + B)' + AB]'C + AB)' + ([D + E][DE]')']' + DE \\ &= ([(A + B)(AB)']C + AB)([D + E][DE]') + DE \\ &= [(A \oplus B)C + AB](D \oplus E) + DE \end{aligned}$$

is exactly the same as the golden design.