디지털회로개론 HW2

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4. For each of the following, find all minimum SOP expressions. (If there is more than one solution, the number of solutions is given in parentheses.) Please write all solutions.

(d) $f(a,b,c,d) = \sum m(5,7,9,11,13,14) + \sum d(2,6,10,12,15)$ $(4\ solutions)$

ab / cd	00	01	11	10
00			X	
01		1	1	1
11		1	X	1
10	X	X	1	X

i) E.P.I : 하늘색 (bd), 보라색 (ad)

ii) 나머지 1인 minterm 13이 커버되도록 고려해야 함. minterm 13의 prime implicant는 빨간색으로 cd', bc, ab 또는 ac 이다.

따라서
- bd + ad + cd'
- bd + ad + bc
- bd + ad + ab
- bd + ad + ac

4가지이다.

5. For each of the following functions, find all of the minimum SOP expressions and all of the minimum POS expressions. Please write all solutions.

(f) $f(a,b,c,d) = \sum m(0,1,4,6,10,14) + \sum d(5,7,8,9,11,12,15)$ (13 SOP & 3 POS solutions)

cd \ ab	00	01	11	10
00	1	1	X	X
01	1	X	0	X
11	0	X	X	X
10	0	1	1	1

i) SOP

① EPI X.

② 두가지로 나뉘는 1찾기 : minterm 0.1.

⇒ PI : $a'c'$, $b'c'$

③ $a'c'$ 먼저.

1) $m_6 . m_{14}$ PI : $bc . bd'$

이후 m_{10} PI : $ab' . ac . ad'$

∴
1. $a'c' + bc + ab'$
2. $a'c' + bc + ac$
3. $a'c' + bc + ad'$
4. $a'c' + bd' + ab'$
5. $a'c' + bd' + ac$
6. $a'c' + bd' + ad'$

2) $m_{10} . m_{14}$ PI : $ac . ad'$

m_6 PI : $a'b$

∴
7. $a'c' + ac + a'b$
8. $a'c' + ad' + a'b$

④ $b'c'$

1) $m_6 . m_{14}$ PI : bd'

이후 m_{10} PI : $ab' . ac . ad'$

∴
9. $b'c' + bd' + ab'$
10. $b'c' + bd' + ac$
11. $b'c' + bd' + ad'$

2) $m_{10} . m_{14}$ PI : $ac . ad'$

이후 m_6 PI : $a'b$

∴
12. $b'c' + ac + a'b$
13. $b'c' + ad' + a'b$

ii) POS

① EPI : $a'b'c$

② 13 포함하는 PI : $bd . ad . ac'$

∴ $f' =$
- $a'b'c + bd$
- $a'b'c + ad$
- $a'b'c + ac'$

$f =$
1. $(a+b+c')(b'+d')$
2. $(a+b+c')(a'+d')$
3. $(a+b+c')(a'+c)$

7. Find a minimum two-level circuit (corresponding to SOP expressions) using AND and one OR gate per function for each of the following sets of functions.

(c)

$f(a,b,c,d) = \sum m(1,3,4,5,10,11,12,14,15)$

$g(a,b,c,d) = \sum m(0,1,2,8,10,11,12,15)$

f

9 gates, 28 inputs

ab / cd	00	01	11	10
00		1	1	
01	1	1		
11	1		1	1
10			1	1

g

ab / cd	00	01	11	10
00	1		1	1
01	1			
11			1	1
10	1			1

f와 g에 겹치는 term : 보라색

나머지 : Implicant

f: $acd + abc'd' + a'b'c'd + a'bc' + acd' + a'b'cd$

g: $acd + abc'd' + a'b'c'd + b'd'$

6. For the following function, f, find all four minimum SOP expressions and all four minimum POS expressions.

yz \ wx	00	01	11	10
00	X	0	1	0
01	X	1	1	0
11	X	0	X	1
10	X	0	X	0

yz is row & wx is column

i) SOP

① EPI : wx.

② m_5 PI : $w'y'z$, $xy'z$

m_{11} PI : wyz, $x'yz$

$\therefore f = \begin{cases} 1 & wx + w'y'z + wyz \\ 2 & wx + w'y'z + x'yz \\ 3 & wx + xy'z + wyz \\ 4 & wx + xy'z + x'yz \end{cases}$

ii) POS

① EPI : $w'z'$, $x'y'$

② 1포함하는 PI : $w'y$, xy

10포함하는 PI : $x'z'$, yz'

$\therefore f' = \begin{cases} 1 & w'z' + x'y' + w'y + x'z' \\ 2 & w'z' + x'y' + w'y + yz' \\ 3 & w'z' + x'y' + xy + x'z' \\ 4 & w'z' + x'y' + xy + yz' \end{cases}$

$f = \begin{cases} 1 & (w+z)(x+y)(w+y')(x+z) \\ 2 & (w+z)(x+y)(w+y')(y'+z) \\ 3 & (w+z)(x+y)(x+y')(x+z) \\ 4 & (w+z)(x+y)(x+y')(y'+z) \end{cases}$

7. For the following five-variable problem, find both minimum SOP expressions.

0 **A** **1**

DE \ BC	00	01	11	10
00	1		1	
01	1	1		
11	1			
10	1			

DE \ BC	00	01	11	10
00			1	
01		1	1	
11		1	1	1
10				1

DE is row & BC is column

① EPI: $A'B'C'$, ~~ACE~~, $ABC'D$, $BCD'E'$

MT PI: $A'B'D'E$, $B'CD'E$

$f = \begin{cases} 1 & A'B'C' + ACE + ABC'D + BCD'E' + A'B'D'E \\ 2 & A'B'C' + ACE + ABC'D + BCD'E' + B'CD'E \end{cases}$