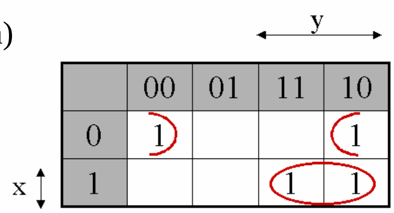
ECE-223, Solutions for Assignment #3

Chapter 3, Digital Design, M. Mano, 3rd Edition

3.3) Simplify the following Boolean functions, using three-variable maps:

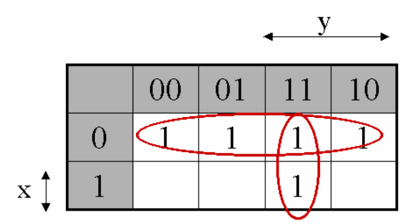
a) $xy + x'y'z' + x'yz'$
b) $x'y' + yz + x'yz'$
c) $A'B + BC' + B'C'$

a)



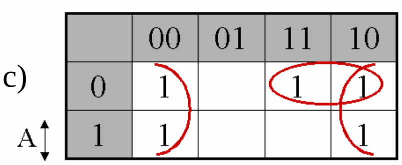
$xy+x'z'$

b)



$x'+yz$

c)

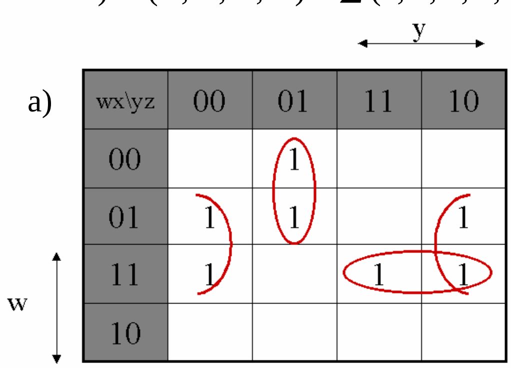


$C' + A'B$

3.5) Simplify the following Boolean functions, using four-variable maps:

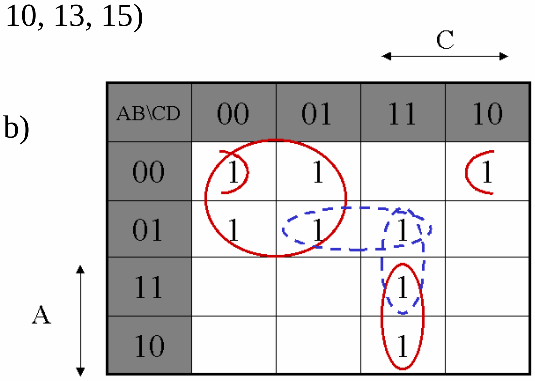
a) $F(w, x, y, z) = \sum (1, 4, 5, 6, 12, 14, 15)$
b) $F(A, B, C, D) = \sum (0, 1, 2, 4, 5, 7, 11, 15)$
c) $F(w, x, y, z) = \sum (2, 3, 10, 11, 12, 13, 14, 15)$
d) $F(A, B, C, D) = \sum (0, 2, 4, 5, 6, 7, 8, 10, 13, 15)$

a)



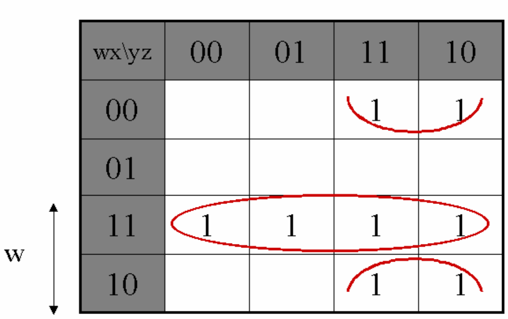
$w'y'z + xz' + wxy$

b)



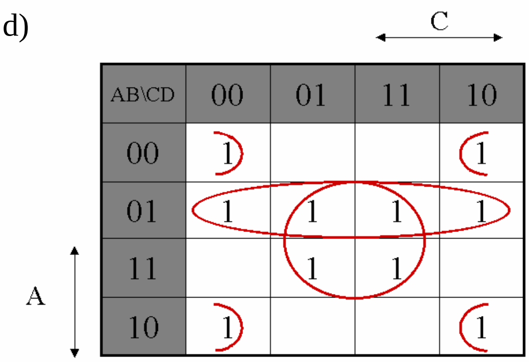
1) $ACD + A'C' + A'B'D' + BCD$
2) $ACD + A'C' + A'B'D' + A'BD$

c)



wx + x′y

d)



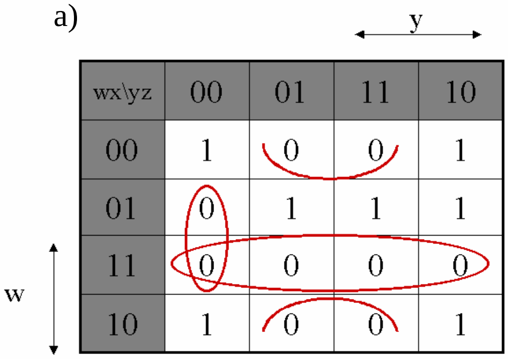
BD + B′D′ + A′B

3.12) Simplify the following Boolean functions in products of sums:

a) $F(w, x, y, z) = \sum (0, 2, 5, 6, 7, 8, 10)$

b) $F(A, B, C, D) = \prod (1, 3, 5, 7, 13, 15)$

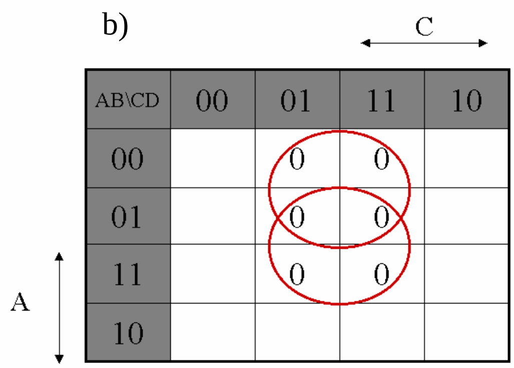
a)



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

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

b)



$F' = BD + A'D$

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

3.13) Simplify the following expressions in (1) sum of the products and (2) products of sums:

a) $x'z' + y'z' + yz' + xy$
b) $AC' + B'D + A'CD + ABCD$
c) $(A' + B' + D')(A + B' + C')(A' + B + D')(B + C' + D')$

a)

x\yz	00	01	11	10
0	1	0	0	1
1	1	0	1	1

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

b)

AB\CD	00	01	11	10
00	0	1	1	0
01	0	0	1	0
11	1	1	1	0
10	1	1	1	0

$F = AC' + CD + B'D = (A+D)(C'+D)(A+B'+C)$

c)

AB\CD	00	01	11	10
00	1	1	0	1
01	1	1	0	0
11	1	0	0	1
10	1	0	0	1

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

3.15) Simplify the following Boolean function *F* , together with the don't-care conditions *d*, and then express the simplified function in sum of minterms:

a) F(x, y, z) = ∑ (0, 1, 2, 4, 5) , d(x, y, z) = ∑(3, 6, 7)
b) F(A, B, C, D) = ∑ (0, 6, 8, 13, 14), d(A, B, C, D) = ∑ (2, 4, 10)
c) F(A, B, C, D) = ∑ (1,3,5,7,9,15), d(A, B, C, D) = ∑ (4,6,12,13)

a)

x\yz	00	01	11	10
0	1	1	x	1
1	1	1	x	x

F = 1 = ∑ (0, 1, 2, 3, 4, 5, 6, 7)

b)

AB\CD	00	01	11	10
00	1			X
01	X			1
11		1		1
10	1			X

F = B′D′ + CD′ + ABC′D
= ∑ (0, 2, 6, 8, 10, 13, 14)

c)

AB\CD	00	01	11	10
00		1	1	
01	X	1	1	X
11	X	X	1	
10		1		

F = A′D + BD + C′D
= ∑ (1, 3, 5, 7, 9,13, 15)

3.16) Simplify the following expressions, and implement them with two-level NAND gate circuits:

a) AB′ + ABD + ABD′ + A′C′D′ + A′BC′
b) BD + BCD′ + AB′C′D′

a) (C over columns 11, 10; A over rows 11, 10)

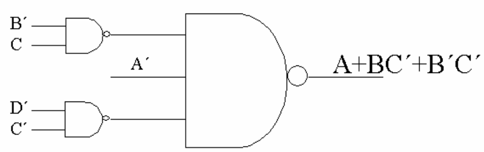
AB\CD	00	01	11	10
00	1	0	0	0
01	1	1	0	0
11	1	1	1	1
10	1	1	1	1

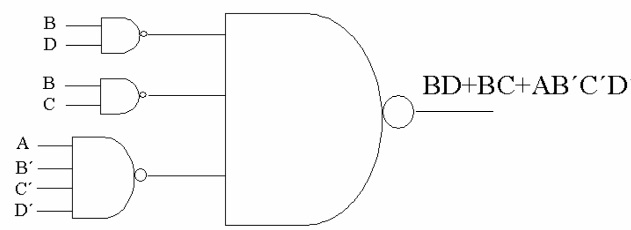
F = A + BC′ + C′D′

b) (C over columns 11, 10; A over rows 11, 10)

AB\CD	00	01	11	10
00	0	0	0	0
01	0	1	1	1
11	0	1	1	1
10	1	0	0	0

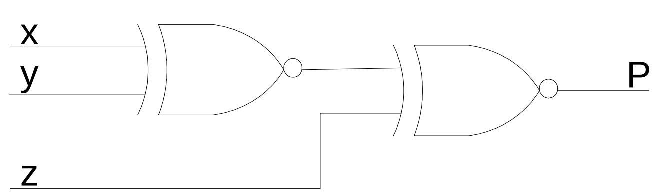
F = BD + BC + AB′C′D′

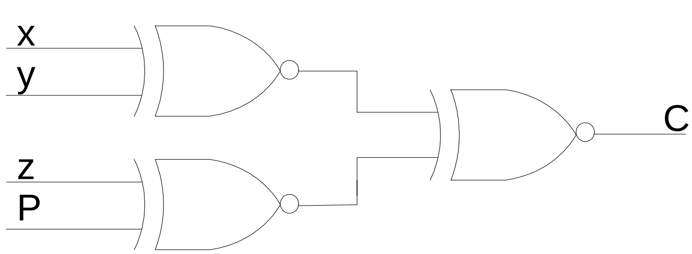




3.28) Derive the circuits for a three-bit parity generator and four-bit parity checker using odd parity bit.

Same as Parity generator described in pages 97-99, Digital Design, M. Mano, 3rd edition





3.29) Implement the following four Boolean expressions with three half adders

a) $D = A \oplus B \oplus C$
b) $E = A'BC + AB'C$
c) $F = ABC' + (A' + B')C$
d) $G = ABC$