

# Assignment 3 - Solution

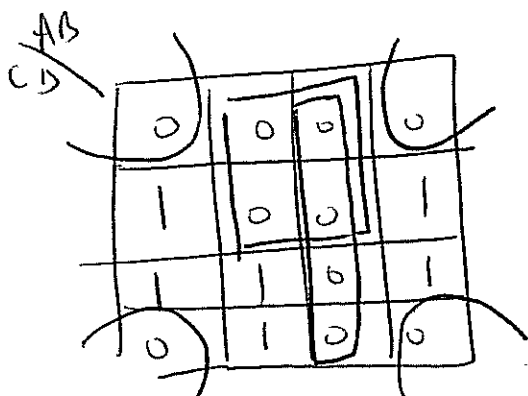
①

Problem 1 → use boolean algebra or K-maps

a)  $[ (A+B) \cdot (C+D) ]'$   
 $= (A+B)' + (C+D)' = \boxed{A'B' + C'D'} \rightarrow \text{SOP}$   
 $= (A'B' + C')(A'B' + D')$   
 $= \boxed{(A' + C')(B' + C')(A' + D')(B' + D')} \rightarrow \text{POS}$

b)  $AB \oplus CD = (AB)' \cdot CD + (AB)(CD)'$   
 $= (A' + B')CD + AB(C' + D')$   
 $= \boxed{A'CD + B'CD + ABC' + ABD'} \rightarrow \text{SOP}$   
 $= ((AB)' \cdot CD + AB)((AB)' \cdot CD + (CD)')$   
 $= ((AB)' + AB)(AB + CD)((CD)' + CD)((CD)' + (AB)')$   
 $= (AB + C)(AB + D)(C' + D' + A' + B')$   
 $= \boxed{(A + C)(A + B)(A + D)(B + D)(C' + D' + A' + B')} \rightarrow \text{POS}$

c)  $((A'BC)'(B'D)')' = \boxed{A'BC + B'D} \rightarrow \text{SOP}$



$$= \boxed{(B+D)(B'+C)(A'+B')} \rightarrow \text{POS}$$

$$d) (a \oplus b)' \cdot (c \oplus d)'$$

②

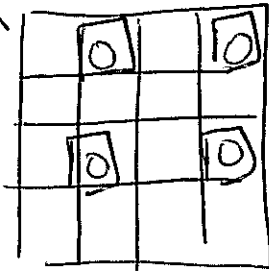
$$= (a \oplus b) + (c \oplus d)'$$

$$= ab + a'b' + (cd + c'd)'$$

$$= ab + a'b' + (c' + d')(c + d)$$

$$= \boxed{ab + a'b' + c'd + cd'}$$

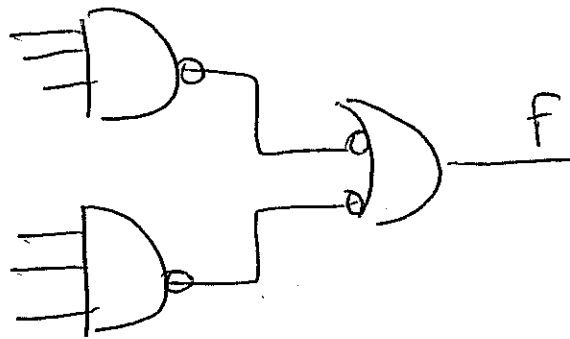
~~ab~~  
~~cd~~



$$= \boxed{\begin{matrix} (a+b'+c+d)(a'+b+c+d) \\ (a+b'+c'+d')(a'+b+c'+d') \end{matrix}}$$

## Problem 2

a)  $xy'z + xyz'$



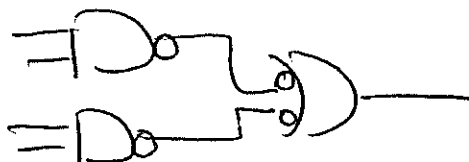
b)

$$AB + A'BC' + BC$$

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

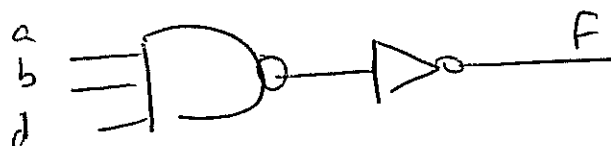
$$B \text{ ————— } F$$

c)  $A'B'C' + AB'C' + AB'C$   
 $= B'(A'C' + AC' + AC) = B'(A'C' + A)$   
 $= B'(C' + A)$   
 $= B'C' + B'A$



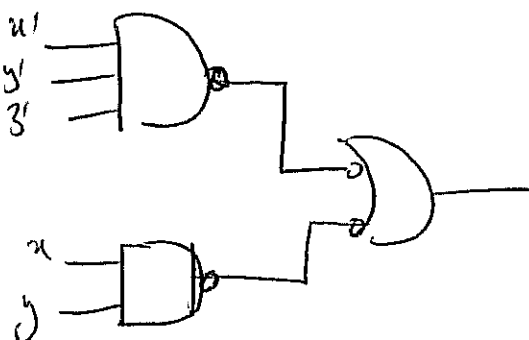
d)  $ab(cd + c'd) = abd$

3



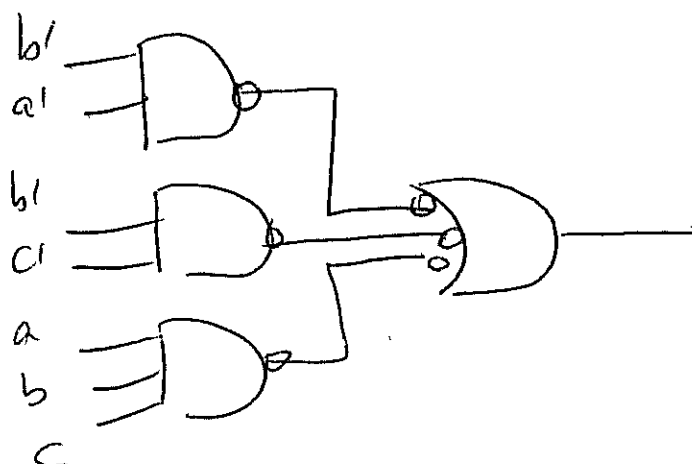
e)  $[x(xy)'] [y(xy)']$   
 $= xy(xy)' = xy(x' + y') = 0$

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



g)  $(a+b)'(a'+b')'$   
 $= a'b'ab = 0$

h)  $a'b'c' + a'b'c + ab'c' + abc$   
 $= a'b' + ab'c' + abc$   
 $= \overbrace{a'b'}^{b'(a' + ac')} + abc$   
 $= b'a' + b'c' + abc$



# Problem 3

(u)

b)  $P = v'w' + v'wy' + vw'z$

$\begin{matrix} & vw \\ yz & \end{matrix}$

1	1	0	0
1	1	0	1
1	0	0	1
0	0	0	0

$$P = v'w' + w'z + v'y'$$

$$= (v' + z)(v' + w')(w' + y')$$

c)  $G = y'z + w'xy' + w'xy + xy'z$

$\begin{matrix} & wx \\ yz & \end{matrix}$

0	1	0	0
1	1	1	1
0	1	0	0
0	1	0	0

$$G = y'z + w'x$$

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

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

d)  $R = f(a,b,c,d) = \prod (2, 3, 4, 6, 7, 10, 11, 12) = \sum (0, 1, 5, 8, 9, 13, 14, 15)$

$\begin{matrix} & ab \\ cd & \end{matrix}$

1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

$\begin{matrix} & ab \\ cd & \end{matrix}$

1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

$$R = abc + b'c' + c'd$$

$$= (a + c')(b + c')(b' + c'd)$$

# Problem 4

5

a)  $S = f(a, b, c, d) = \sum (1, 5, 7, 8, 9, 10, 11, 13, 15)$

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

prime implicant:  $ad$ .

$$S = \underbrace{c'd}_{\text{essential PI}} + \underbrace{bd}_{\text{essential PI}} + \underbrace{ab'}_{\text{essential PI}}$$

b)  $T = f(a, b, c, d, e) = \sum (0, 4, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 24, 28)$

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

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

$$T = \underbrace{d'e'}_{\text{essential PI}} + \underbrace{a'b}_{\text{essential PI}}$$