①

Digital & Logic Design

Assignment #03

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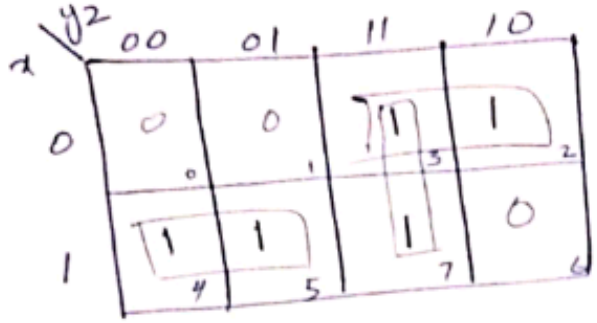
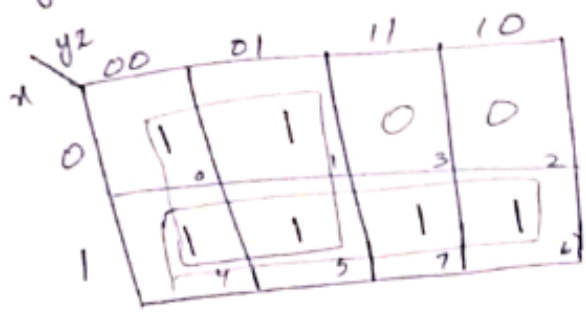
(3·2)

a) $F(x,y,z) = \Sigma(2,3,4,5,7)$



$= xy' + x'y + yz$

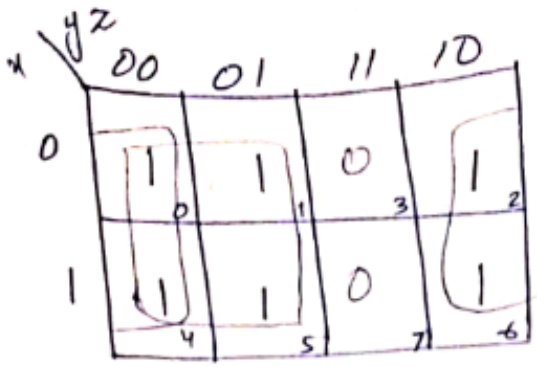
b) $F(x,y,z) = \Sigma(0,1,4,5,6,7)$



$= x + y'$

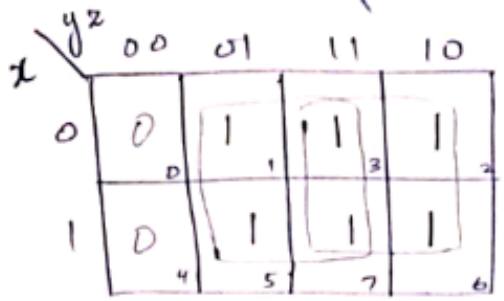
(2) $x = 1 + \cos 5.0$

c) $F(x,y,z) = \Sigma(0,1,2,4,5,6)$



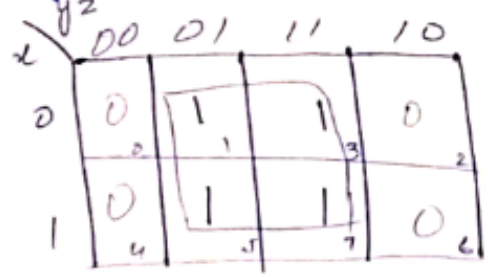
$= z' + y'$

d) $F(x,y,z) = \Sigma(1,2,3,5,6,7)$



$= z + y$

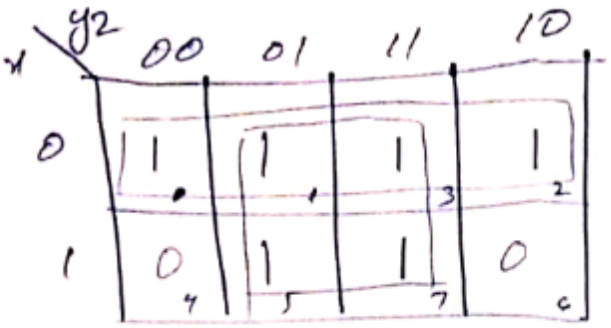
e) $F(x,y,z) = \Sigma(1,3,5,7)$



$= z$

f) $F(x, y, z) = \Sigma(0, 1, 2, 3, 5, 7)$

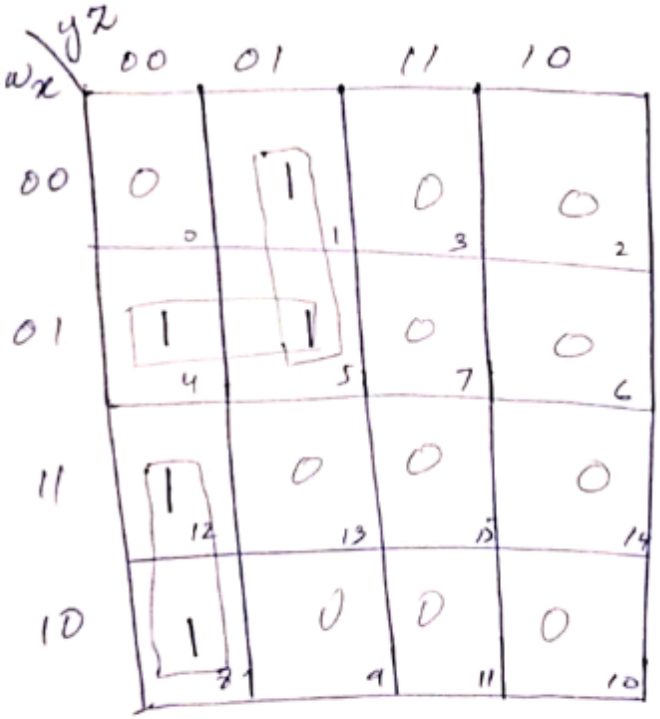
a)



$= x' + z$

(3.4)

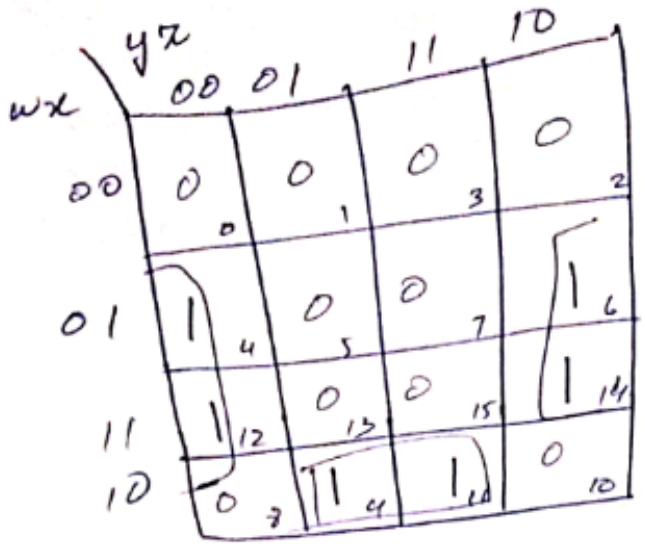
a) $F(w, x, y, z) = \Sigma(1, 4, 5, 8, 12)$



$= wy'z' + w'xy' + w'y'z$

4

b) $F(w,x,y,z) = \Sigma(4,6,9,11,12,14)$



$= xz' + wx'z$

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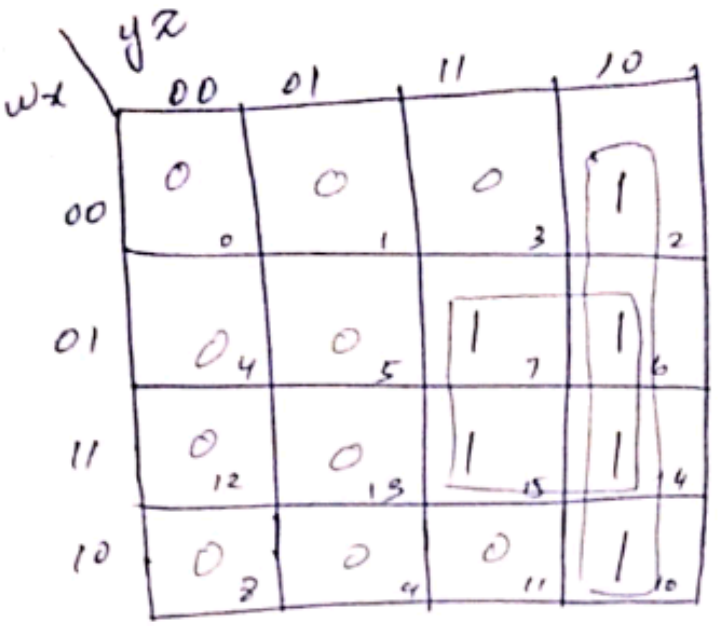
c) $F(w,x,y,z) = \Sigma(1,3,5,6,7,9,11)$

$= x'z + w'z + w'xy$

d) $F(w,x,y,z) = \Sigma(2,6,7,10,14,15)$



$= xy + yz'$

e) $F(w,x,y,z) = \Sigma(9,10,11,12,13,15)$

$= wx y' + wz + wx'y$

f) $F(w,x,y,z) = \Sigma(0,2,4,6,9,11,13,15)$

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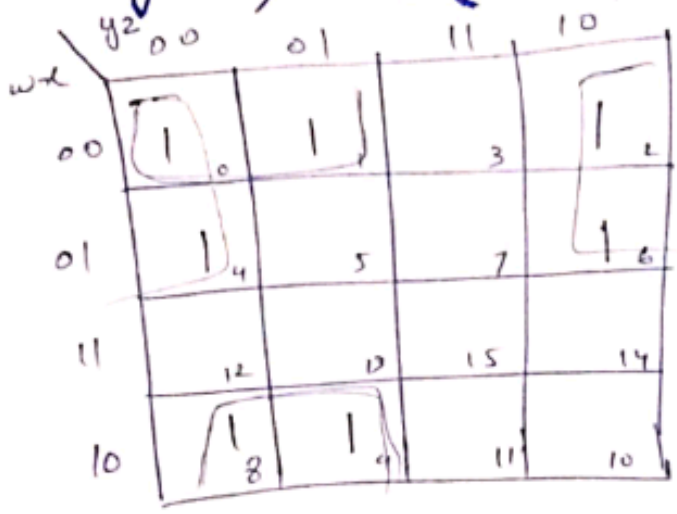
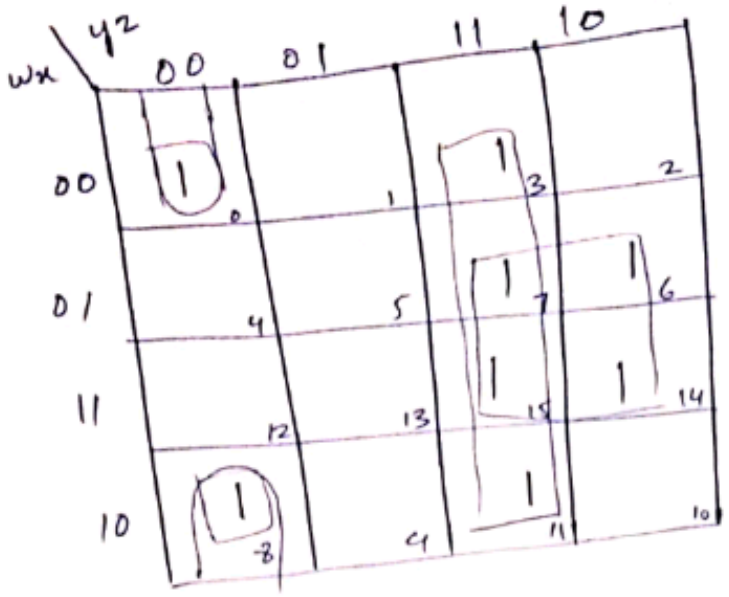
$= w'z' + wz = 1$

g) $F(w,x,y,z) = \Sigma(0,1,2,4,6,8,9)$



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

h) $F(w,x,y,z) = \Sigma(0,3,6,7,8,11,14,15)$



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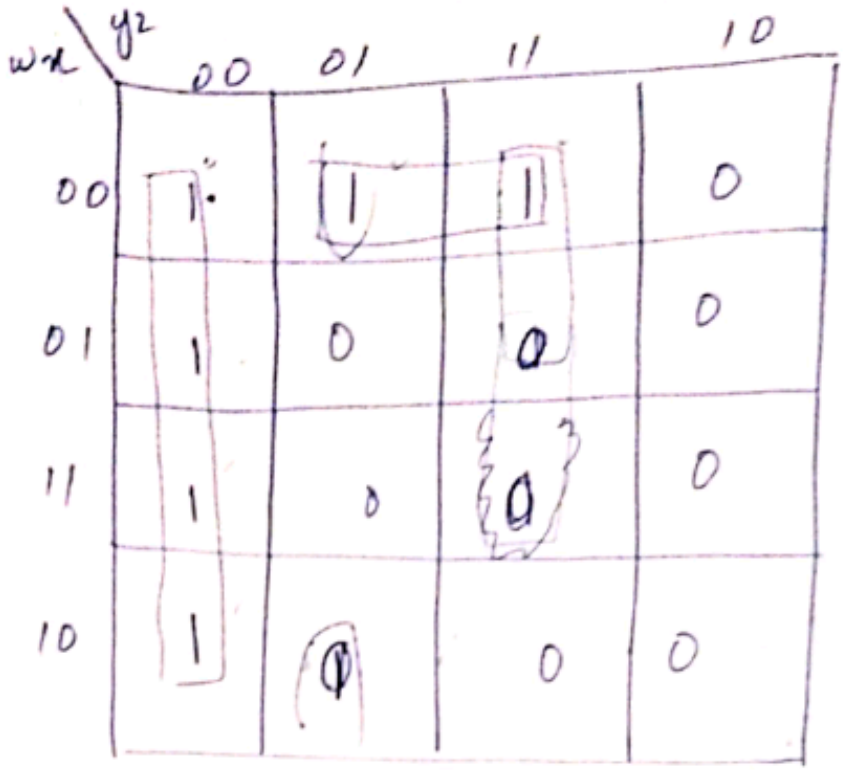
$= x'y'z' + yz + xy$

(3.6)

a) $ABC'D' + A'B'C + B'C'D' + AB'CD + B'C'D$

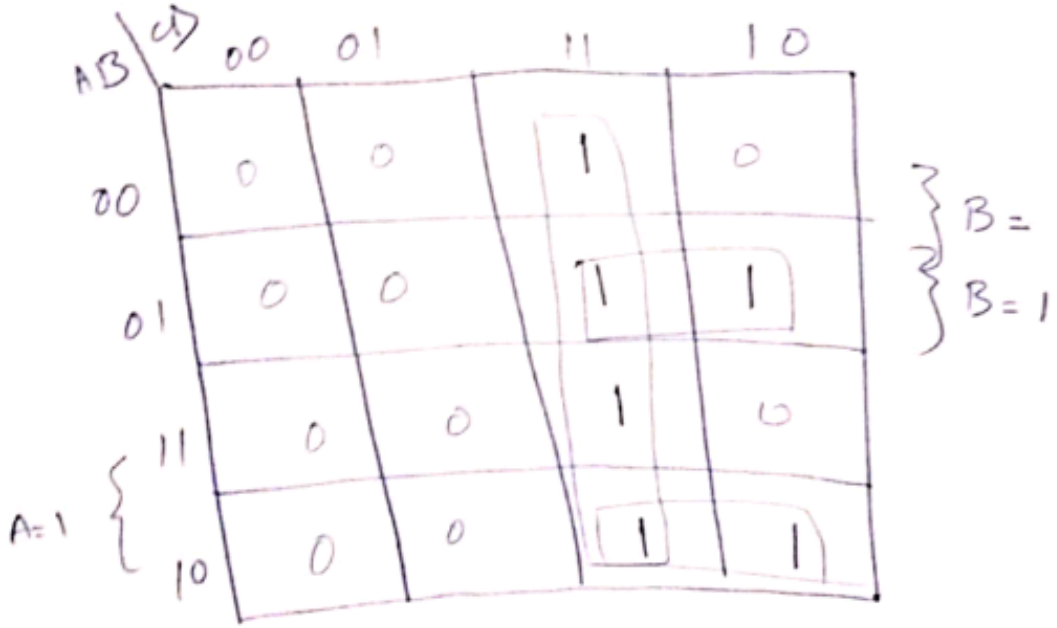
$= AB' + AC'D' + B'C'$

b) $w'x'y' + w'x'yz + x'y'z + xyz + y'z'$



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

c) $A'B'CD + A'BC + C'D + ABCD + AB'C$

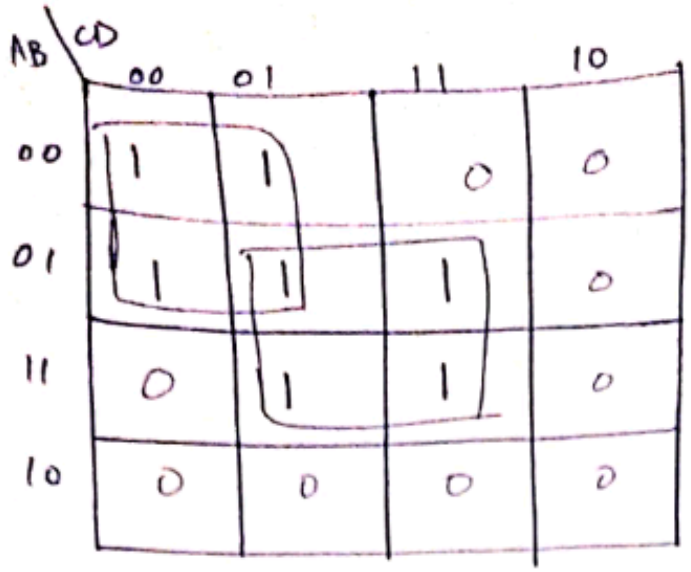


$= CD + A'BC + AB'C$

n

(3.6)

a) $A'B'C' + A'BD + A'BC'D' + BC'D + ABCD$



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$= A'C' + BD$

(3.8)

a) $w'x + xz + wyz$

$= \Sigma(4, 5, 6, 7, 11, 13, 15)$

b) $ABD' + BC'D + CD$

AB \ CD	00	01	11	10
00	0 (0)	0 (1)	1 (3)	0 (2)
01	0 (4)	1 (5)	1 (7)	0 (6)
11	1 (12)	1 (13)	1 (15)	1 (14)
10	0 (8)	0 (9)	1 (11)	0 (10)

$= \Sigma(3, 4, 5, 6, 7, 11, 12, 13, 14, 15)$

c) $x'y'z' + xy + y'z$

x \ yz	00	01	11	10
0	1 (0)	1 (1)	0 (3)	0 (2)
1	0 (4)	1 (5)	1 (7)	1 (6)

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$= \Sigma(0, 1, 5, 6, 7)$

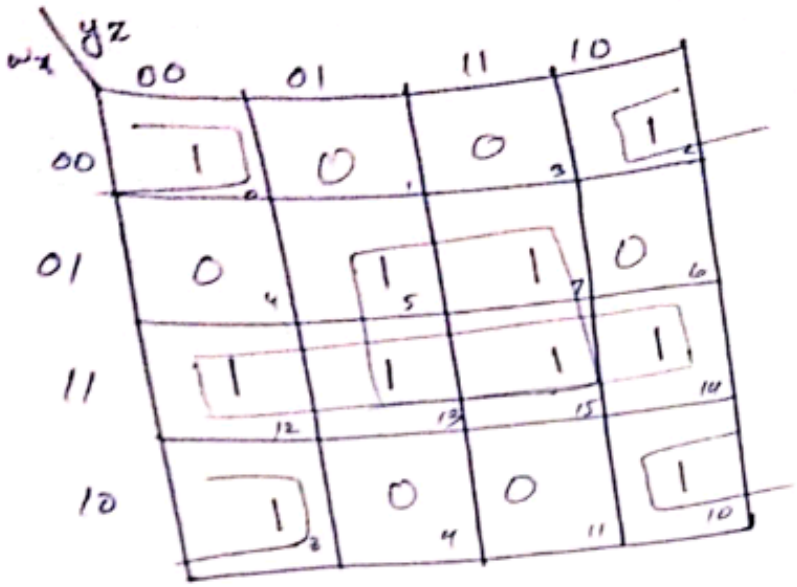
d) $AB + B'C'D' + BCD + A'C'D'$

AB \ CD	00	01	11	10
00	1 (0)	0 (1)	0 (3)	(2)
01	1 (4)	0 (5)	1 (7)	0 (6)
11	1 (12)	1 (13)	1 (15)	1 (14)
10	1 (8)	0 (9)	0 (11)	0 (10)

$= \Sigma(0, 4, 6, 7, 8, 12, 13, 14, 15)$

a) (3.20)

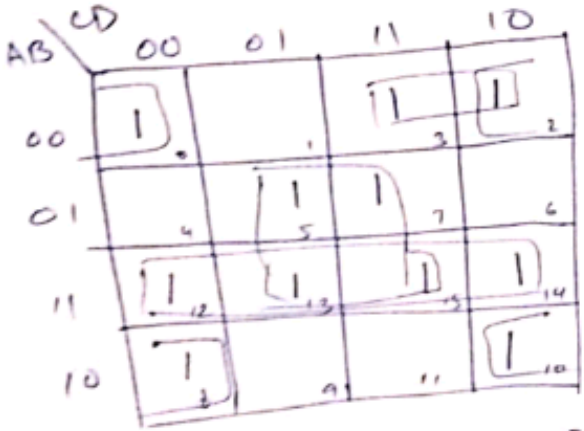
$F(w, x, y, z) = \Sigma(0, 2, 5, 7, 8, 10, 12, 13, 14, 15)$



Essential : xz, ~~$w'x'z'$~~ $x'z'$, wx

boolean expression: $xz + wx + x'z'$

b) $F(A, B, C, D) = \Sigma(0, 2, 3, 5, 7, 8, 10, 12, 13, 14, 15)$



Essential: $B'D'$, AB, BD, $A'B'C$

boolean expression : $AB + B'D' + BD + A'B'C$

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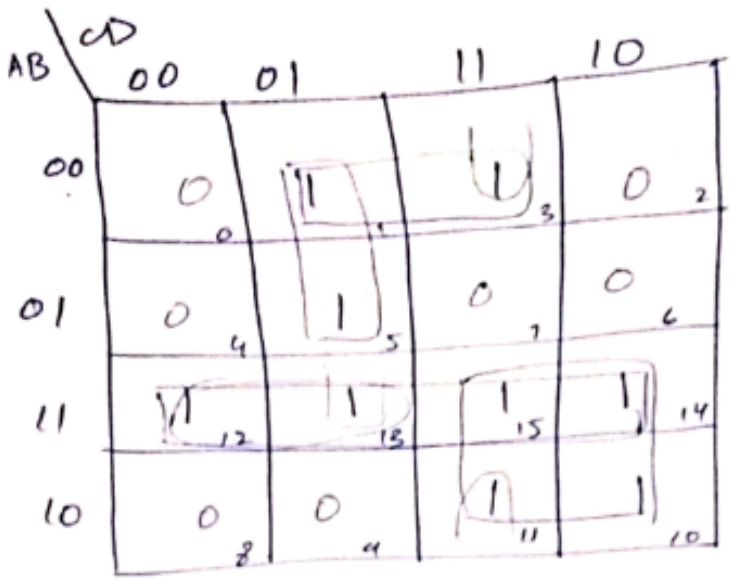
c) $F(A,B,C,D) = \Sigma(1,3,4,5,10,11,12,13,14,15)$



Essentials: ~~AB, AC~~, A'B'D

boolean expression: ~~A'C'D + AB + AC +~~ A'B'D

AB, A'B'D, B'CD, A'C'D
BC', AC
BC', AC + A'B'D

Expression = AC + A'B'D + BC'

Essential = AC, BC'

non-Essential = A'C'D, B'CD, AB, A'B'D

d) $F(w,x,y,z) = \Sigma(0,1,4,5,6,7,9,11,14,15)$

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

Essential => w'y', xy

non-Essential => x'y'z, wyz, w'x, wx'z

e) $F(A,B,C,D) = \Sigma(0,1,3,3,8,9,10,13,15)$

$F = B'C' + AB'D' + ABD + A'CD$

Essential = $B'C'$, ~~ABD~~, $AB'D'$

non-essential = $AC'D$, ABD, BCD, $A'CD$, $A'B'D$,

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f) $F(w,x,y,z) = \Sigma(0,1,2,4,5,6,7,10,15)$

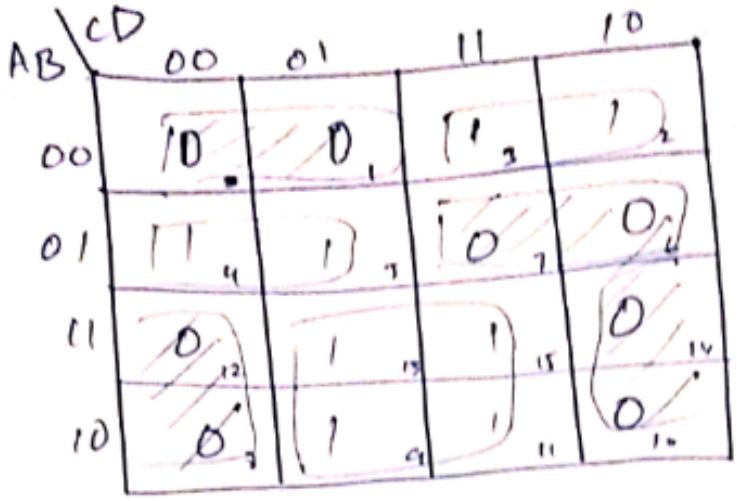
$F = w'y' + w'x + xyz + x'yz'$

Essential = $w'y'$, xyz, $x'yz'$

non-Essential = $w'x$, $w'x'z'$,

(3.12)

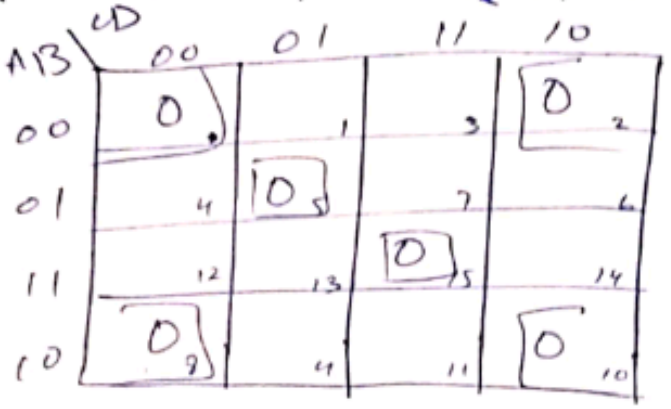
a) $F(A, B, C, D) = \pi(0, 1, 6, 7, 8, 10, 12, 14)$



$F = \cancel{AD' + A'BC + A'B'C'}$

$F = A'B'C + A'BC' + AD$

b) $F(A, B, C, D) = \pi(0, 2, 5, 8, 10, 15)$



$= \cancel{(B' + D')A'}$ In POS form

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

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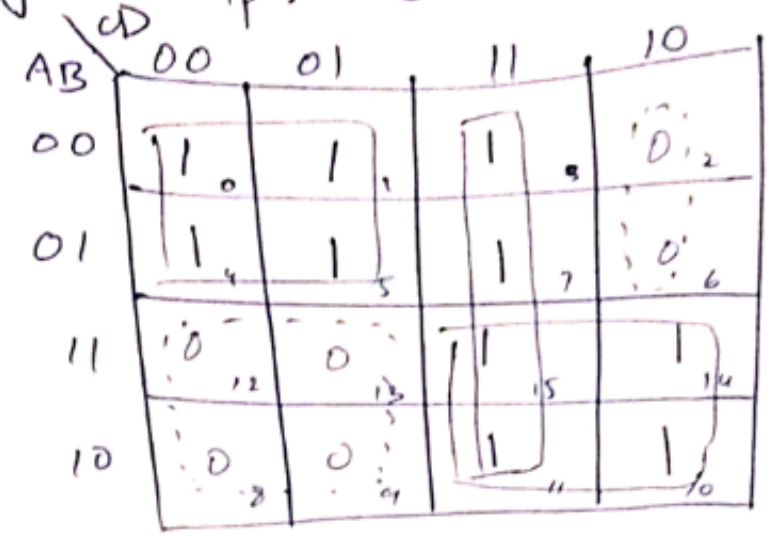
(3.14)

$F = A'B'C' + A'CD + A'C'D' + A'BD + ABC + AB'C$

(1) By K-map: (in SOP)



$F = A'C' + CD + AC$

(2) By K-map: (in POS) BSE-133

considering zero pairs:
(presented by dots)

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

(3) By simplification:

$= A'B'C' + A'CD + A'C'D' + A'BD + ABC + ABC$

$= C'(A'B' + AB) + A'(CD + C'D') + A'BD + ABC$

$= A' + C' + A'BD + ABC$

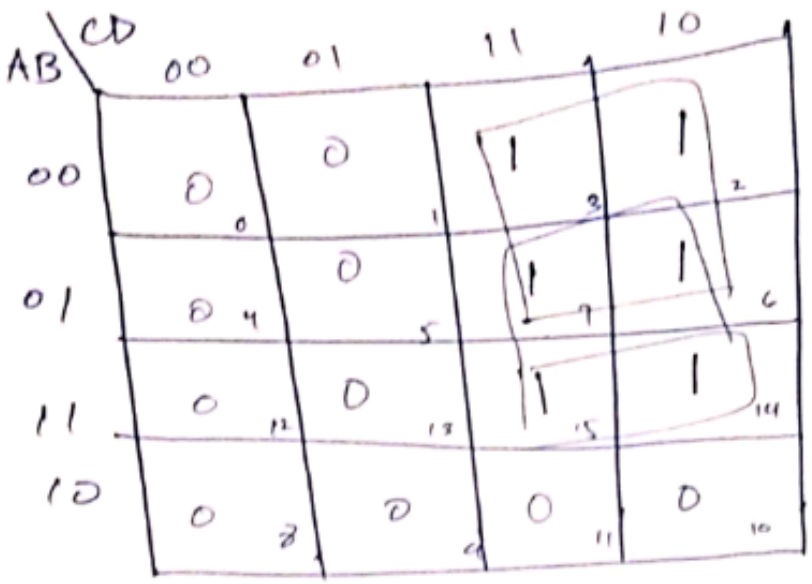
$= A'(1 + BD) + C' + ABC$

$= A'C' + CD + AC$

$=$

(3.16)

a) $F(A,B,C,D) = A'B'C + A'BC + ABC$



~~$A'C + ABC$~~

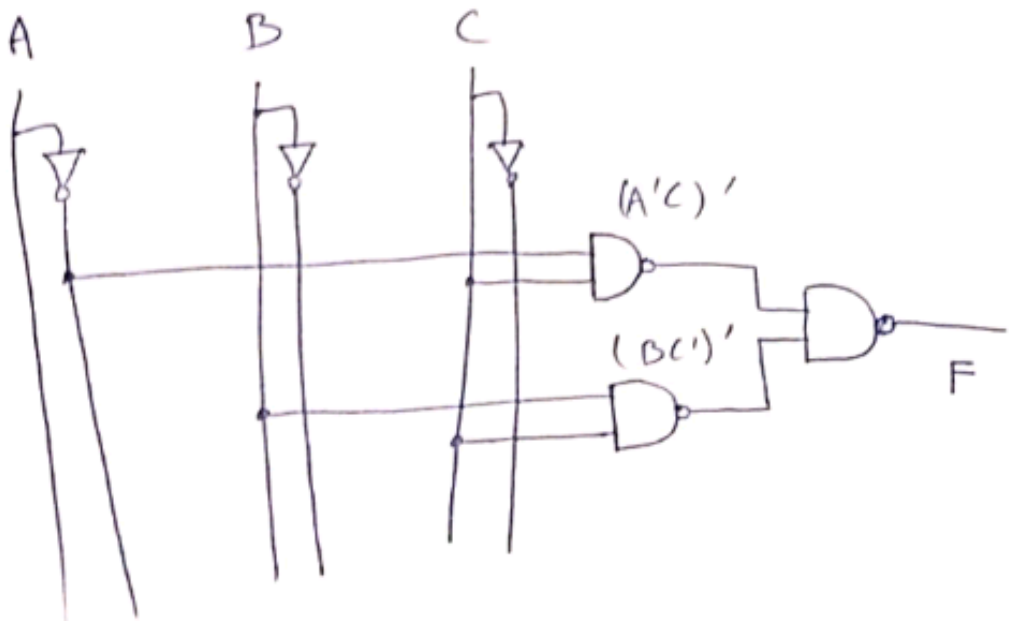
or

$F = A'C + BC$

BSE-133

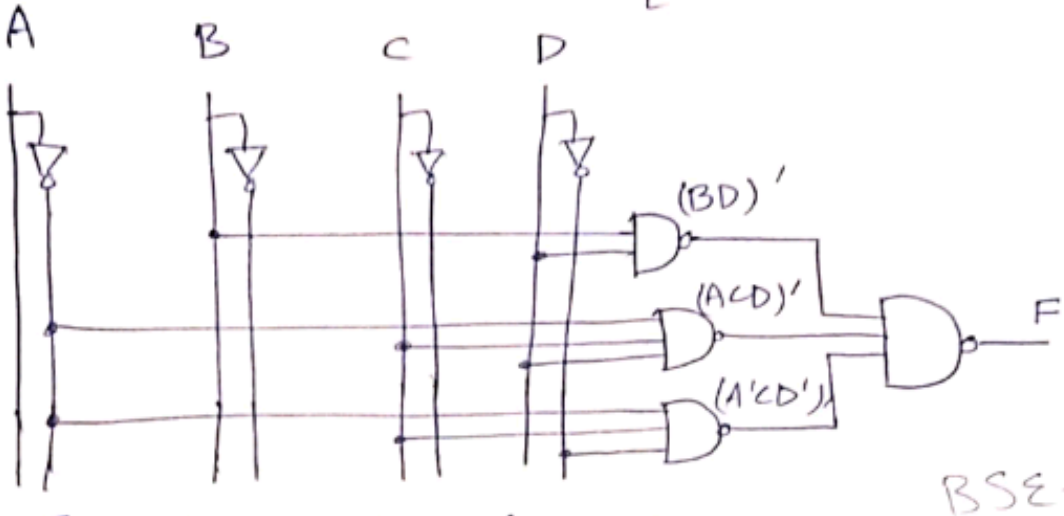
$= [(A'C + BC)']'$

$((A'C)' \cdot (BC)')'$



b) $F(A,B,C,D) = A'CD' + A'BD + ABD + AB'CD$

$F = BD + ACD + A'CD' = [(BD)' \cdot (ACD)' \cdot (A'CD')]'$



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c) $F(A,B,C,D) = (A'+B'+C)(A'+B'+C')(B'+C'+D)$

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

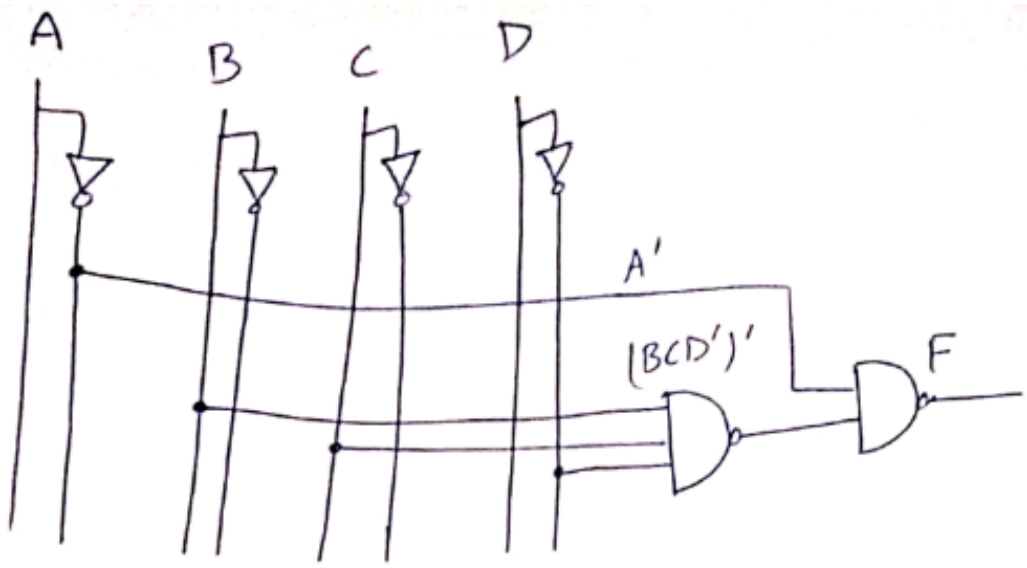
$= (A'B')(B'+C'D)$

$(F')' = [(A'B')+(B'+C'D)]'$

$= [A+B+BCD']'$

$= [(A+BCD')']'$

$= [A'(BCD')']'$



d) $F(A,B,C,D) = AB'D' + AD + A'BD$

$F = BD + AB'$

$(F')' = [(BD)' \cdot (AB')']'$

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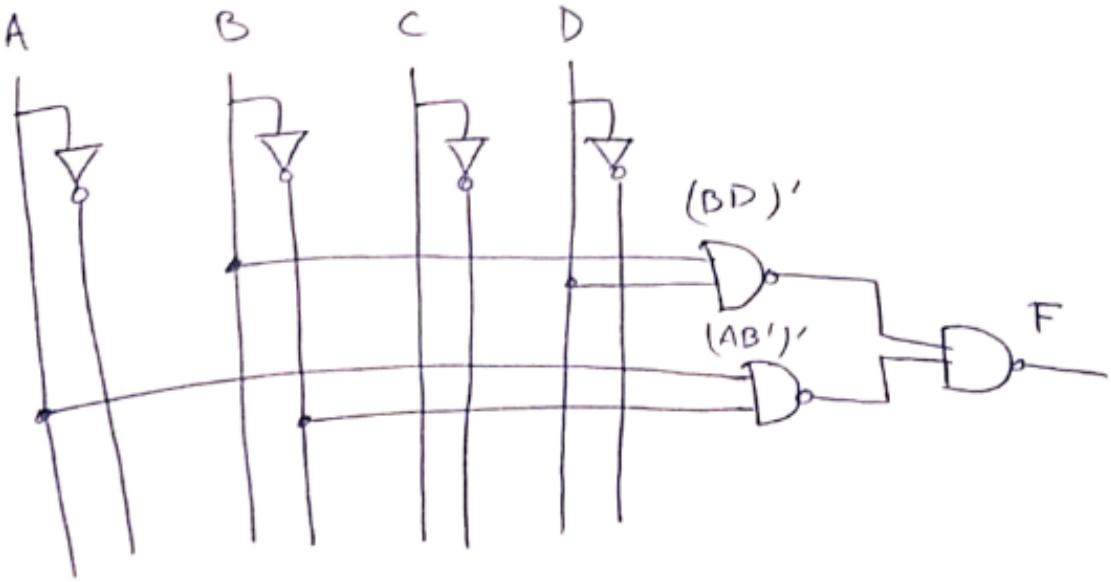


(3.18)

a) $(A \oplus B)'(C \oplus D)$

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

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

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

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

$= ABC'D + ABCD' + A'B'C'D + A'B'CD'$

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

$F = CD + C'D' + A'B + AB'$

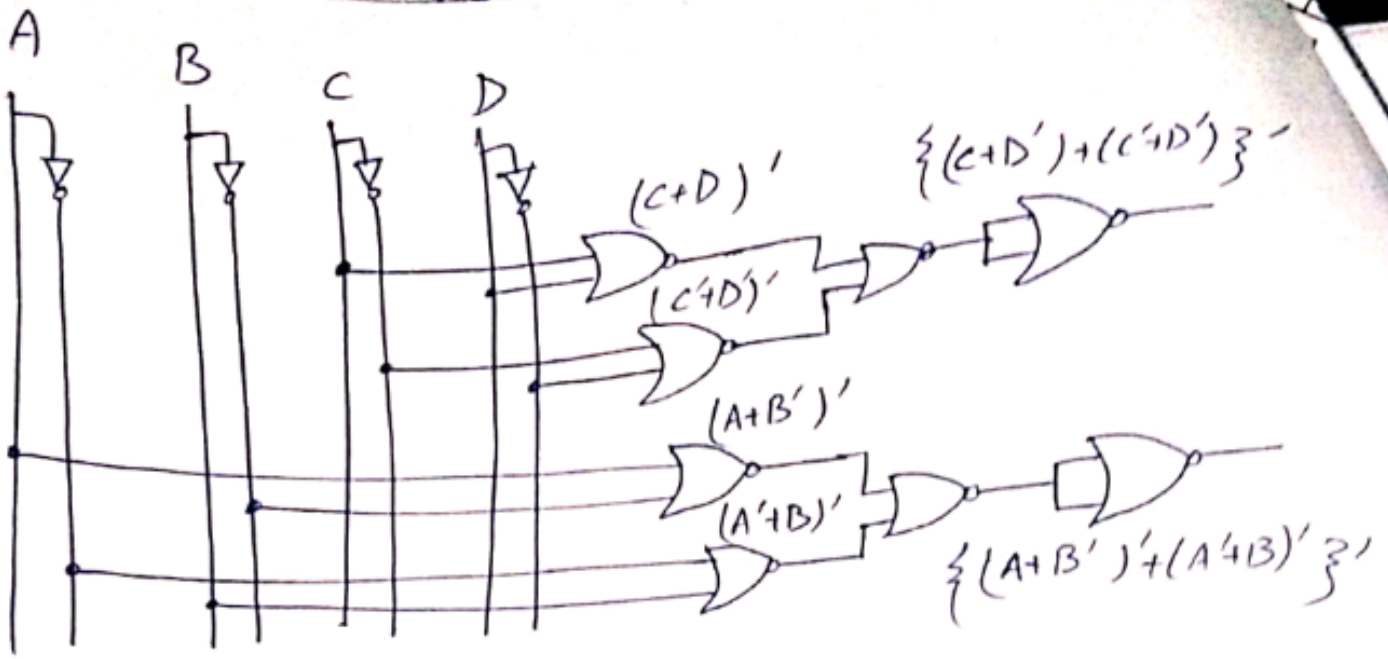
$(F)' = [(C'D' + CD + A'B + AB')']'$

$= [(C + D)(C' + D')(A + B')(A' + B)]'$

$= [(C + D)' + (C' + D)' + (A + B')' + (A' + B)']'$

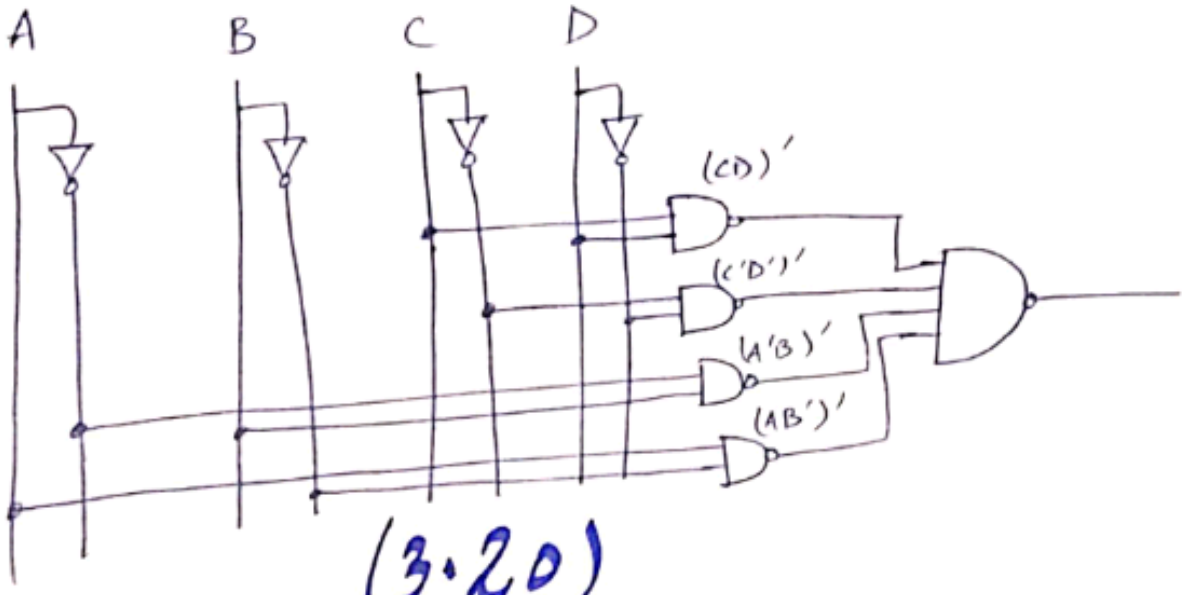
$= [[\{(C + D)' + (C' + D')\}' \cdot \{(A + B')' + (A' + B)'\}]']'$

$= [[(C + D') + (C' + D')\}']' + [\{(A + B')' + (A' + B)'\}']'$



b)

$$F = [(CD) + (C'D')' (A'B)' (AB')']'$$



(3.20)

By mutiple NOR:

$$F = CD(B+C)A + (BC' + DE')$$

$$F' = [[CD(B+C)A + (BC' + DE')]']'$$

$$= [[\{(CD(B+C)A)'\}' + \{((BC' + DE')']']'$$

$$= [[\{(ABCD + ACD)'\}' + \{ \text{---} \}']']'$$

$$= [[\{(CD + (B+C) + A)'\}' + \{ - \}']']'$$

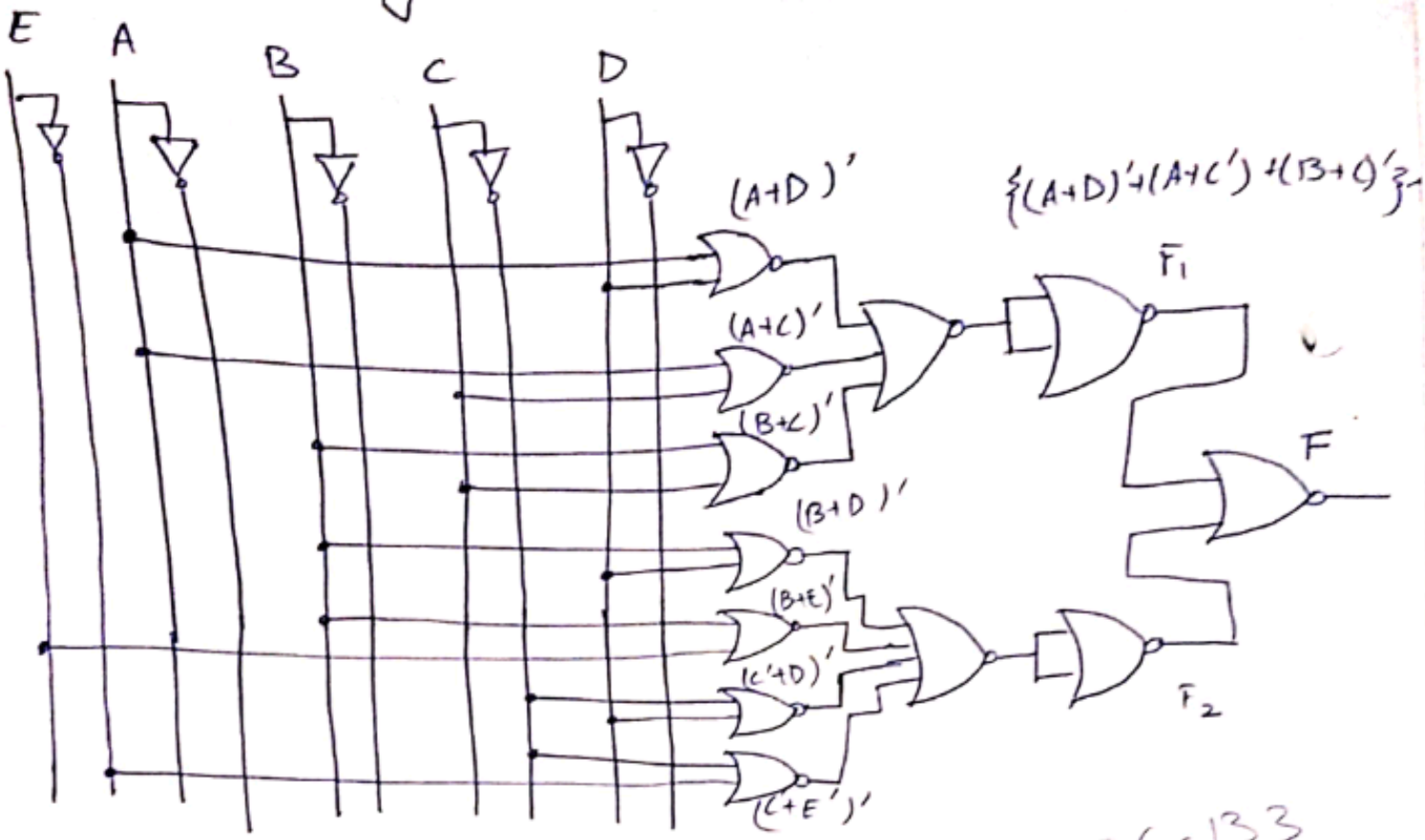
$$= [[\{((A+D)'(A+C)'(B+C))' + \{(B+D)' + (B+E)'$$

$$(C'+D')(C'+E')\}'']$$

TWO

$$F' = [[[\{(A+D)' + (A+C)' + (B+C)'\}' + \{(B+D)' + (B+E)' + (C'+D)' + (C'+E')'\}']']'$$

Logic Diagram:



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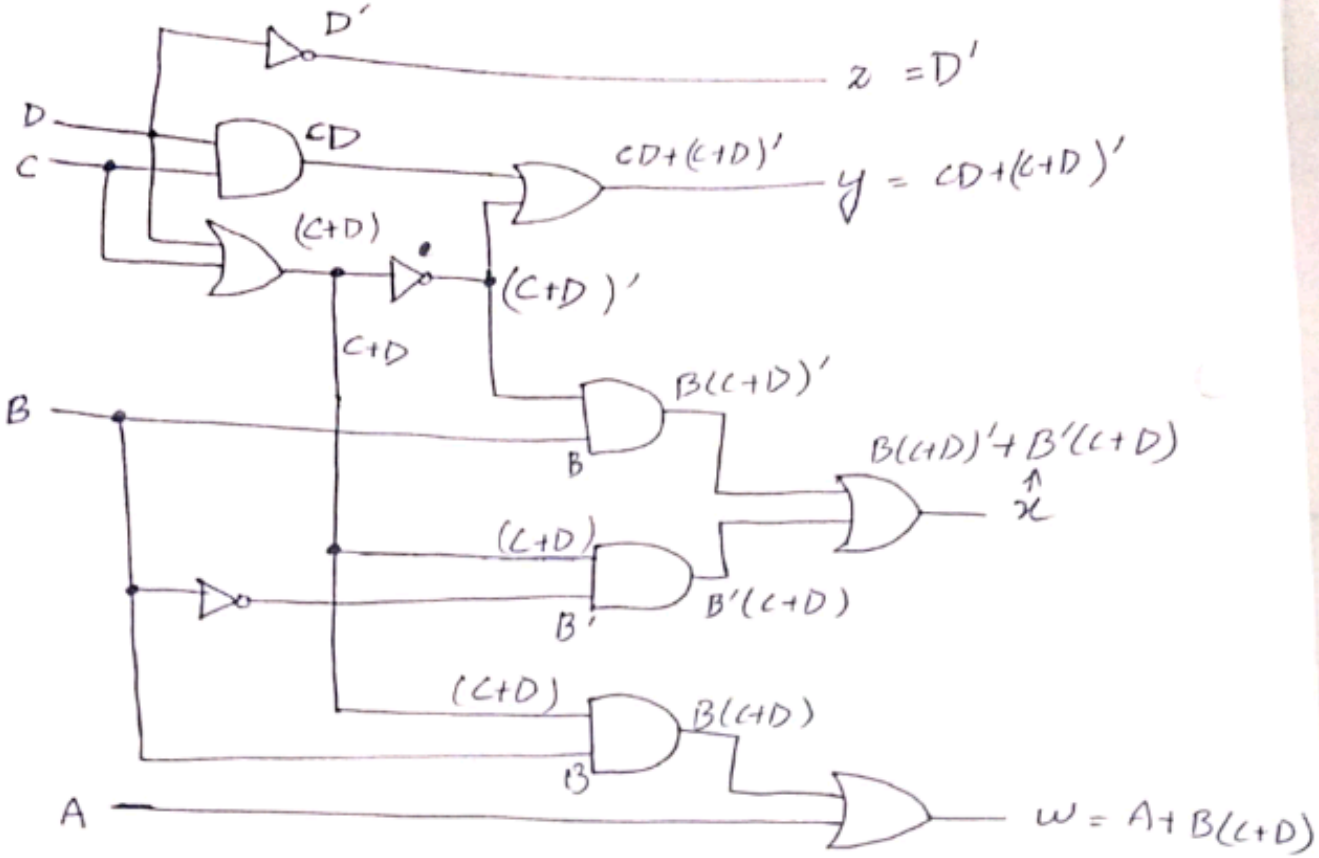
(3.22)

Apply two level NAND gate to fig 4.4



$y = CD + (C+D)'$

$= [[CD + (C+D)']']'$

$= [(CD)' \cdot (C+D)'']'$

$y' = [(CD)' \cdot (C'D')']' \Rightarrow [(CD')' \cdot (C'D')']'$

$x = [(B(C+D') + B'(C+D))']'$

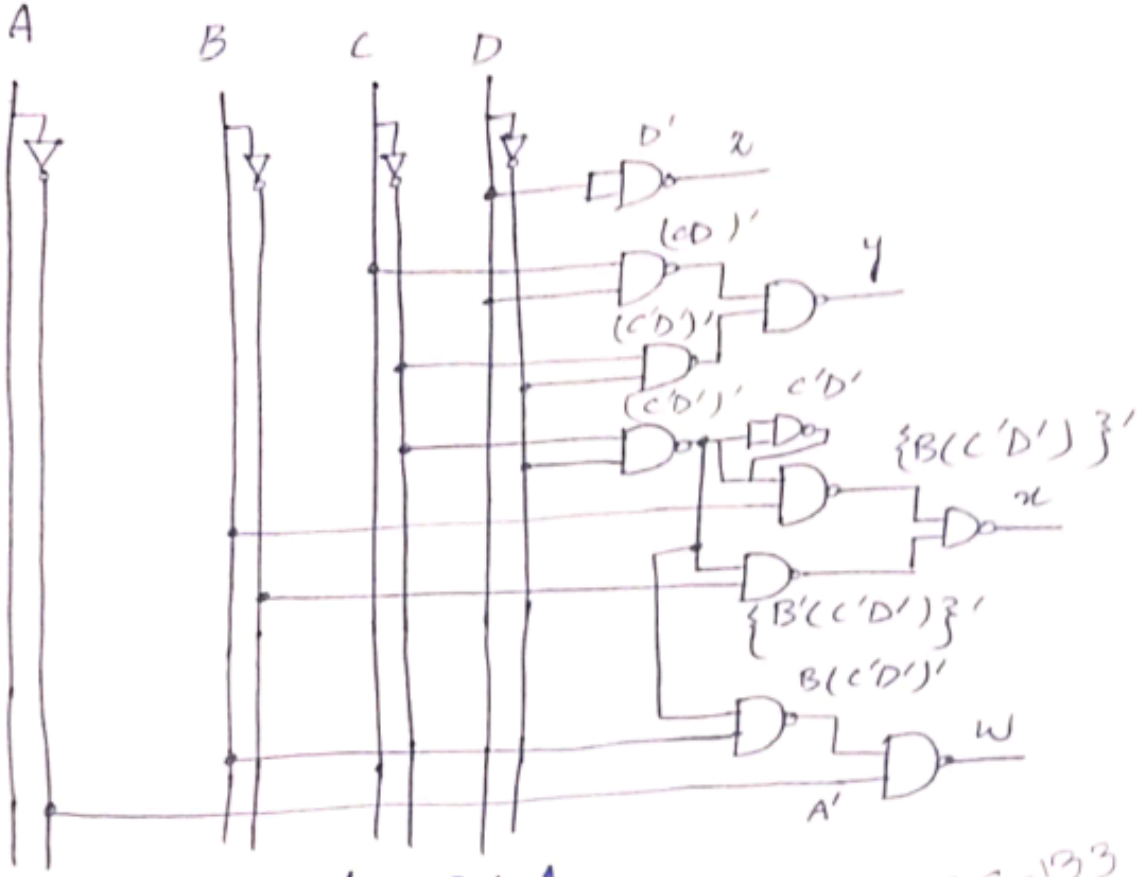
$= [(B(C+D'))' \cdot (B'(C+D))']'$

$= [\{B'(C'D)' \cdot B(C'D')\}]'$

$$w = [\{A + B(C+D)\}']' = [\{A + B(C'D')'\}']'$$

$$= [\{A' \cdot B(C'D')'\}']'$$

$$z = D'$$



(2.24)

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Implement
NAND, AND, AND-NOR, OR-NAND, NOR-OR

$$F\{A,B,C,D) = \Sigma(0,4,8,9,10,11,12,14)$$

$$F' = A'D + A'C + BD$$

$$F \Rightarrow \{A'D + A'C + BD\}' \rightarrow (b)$$

removing complement

$$\Rightarrow (A'D)' \cdot (A'C)' \cdot (BD)' \rightarrow (a)$$

OR: consider 1's:

$$F = C'D' + AB' + AD'$$

$$\Rightarrow [\{C'D' + AB' + AD'\}']'$$

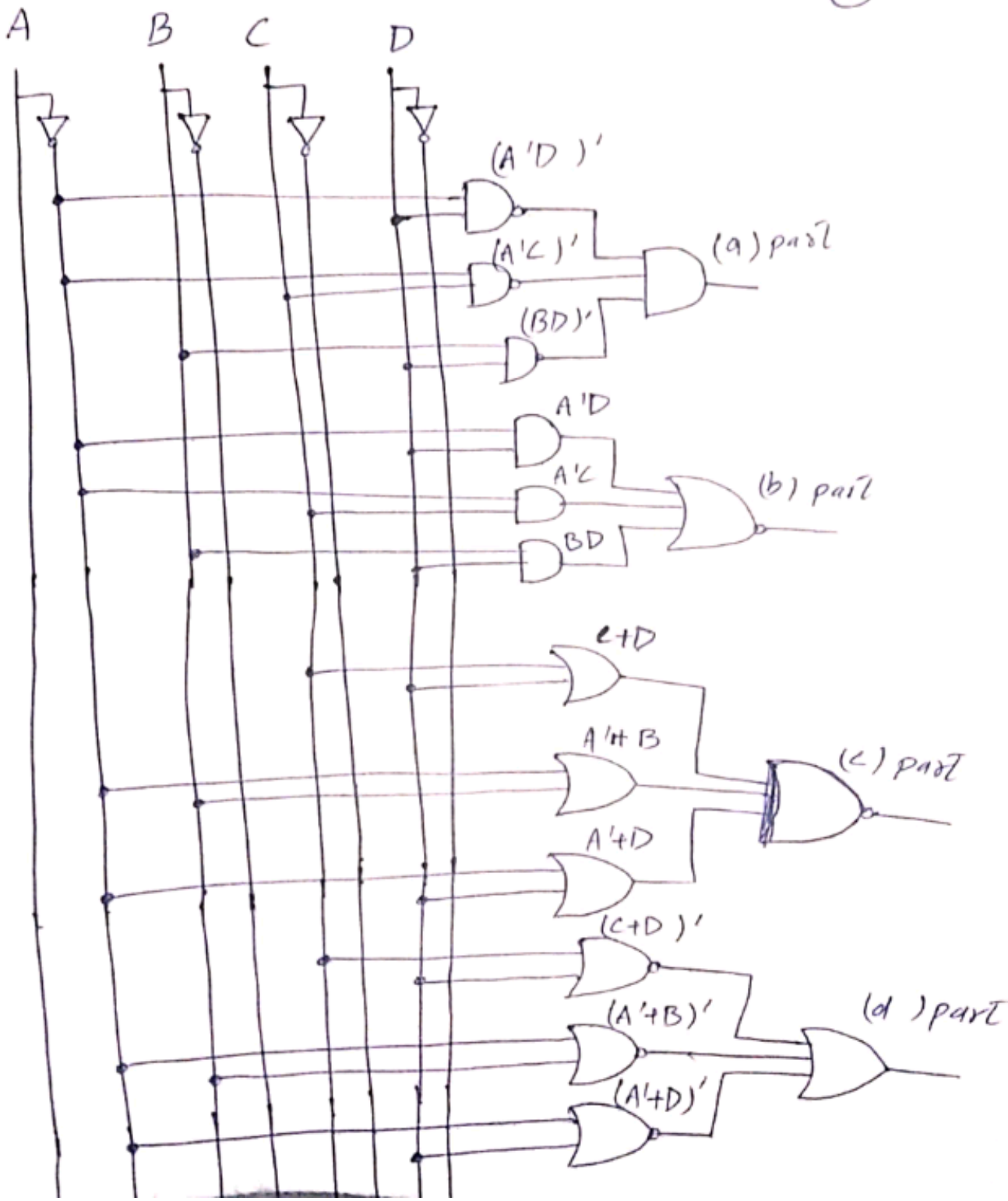
$$F = [\{C'D' + AB' + AD'\}']'$$

$$= [(C'D')' \cdot (AB')' \cdot (AD')']'$$

$$= [(C+D)(A'+B)(A'+D)]' \rightarrow \text{OR-NAND}$$ (e)

$$F = C'D' + AB' + AD'$$

$$(C+D)' + (A'+B)' + (A'+D)' \rightarrow \text{NOR-OR}$$ (a)



(2.26)

Find SoP from F = fg

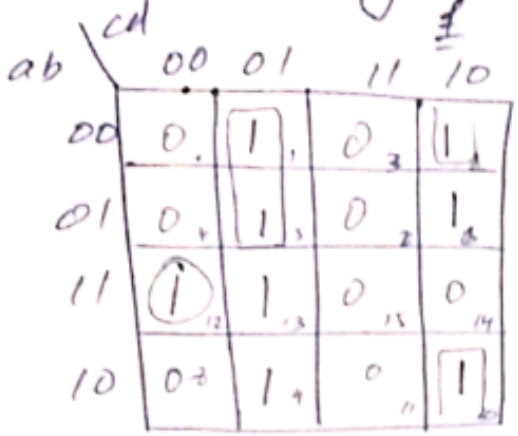
$f = abc' + c'd + a'cd' + b'cd'$

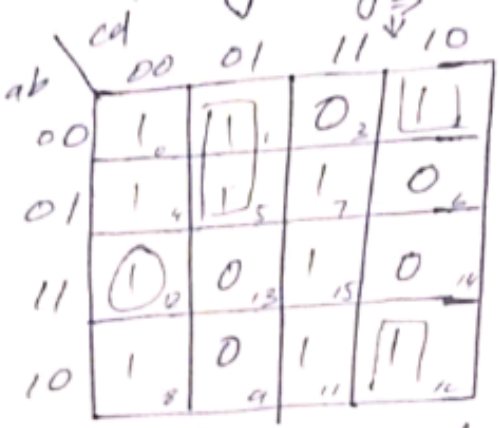
$g = (a+b+c'+d')(b'+c'+d)(a'+c+d')$

By first converting 'g' to SoP

$g' = a'b'cd + bcd' + ac'd$

Now sketching K map of f & g'





In case of complemented consider '1' as zeroes.

Take comon pairs:

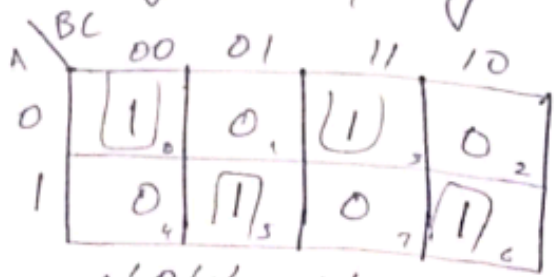
$F = fg \Rightarrow a'c'd + abc'd' + b'cd'$

(2.28)

3 bit parity generator using odd parity

A	B	C	P
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

0 - odd
1 - even



$P = A'B'C' + A'BC + AB'C + ABC'$

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

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

$P = A \oplus B \oplus C$ — ①

4 bit parity checker using odd parity

A	B	C	P	P Checker
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

0 - odd
1 - even

AB \ CP	00	01	11	10
00	1 (0)	0 (1)	1 (3)	0 (2)
01	0 (4)	1 (5)	0 (7)	1 (6)
11	1 (12)	0 (13)	1 (15)	0 (14)
10	0 (8)	1 (9)	0 (11)	1 (10)

$= A'B'C'P' + A'B'CP + A'BC'P + A'BCP' +$
$+ ABC'P' + ABCP + AB'C'P + AB'CP'$

$= A'B'(C'P' + CP) + A'B(C'P + CP') + AB(C'P' + CP)$
$+ AP'(C'P + CP')$

$= A'B'(C \odot P) + A'B(C \oplus P) + AB(C \odot P) + AB'(C \oplus P)$

$= (A'B' + AB)(C \odot P) + (A'B + AB')(C \oplus P)$

$= (A \odot B)(C \odot P) + (A \oplus B)(C \oplus P)$

$C = (A \odot B) \odot (C \odot P)$ - ②

① $A'B' + AB$

$A \odot B$

↓ XNOR

② $A'B + AB'$

$A \oplus B$

↓ XOR

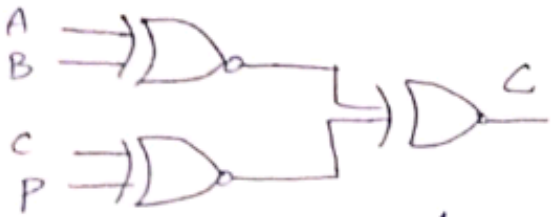
Equations:

$P = A \oplus B \oplus C$

$C = (A \odot B) \odot (C \odot P)$

① 

BSE-B3

② 

(3.30)

Implement XOR & AND gates:

$F = AB'CD' + A'BCD' + AB'C'D + A'BC'D$

Taking Common

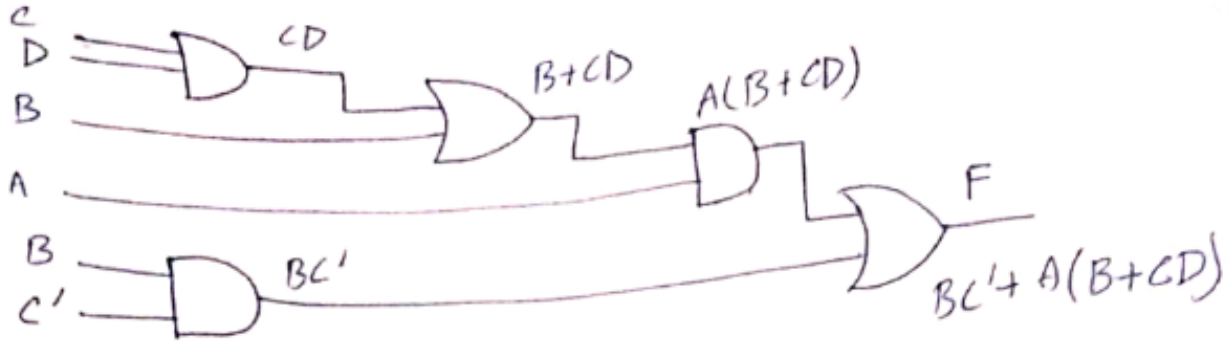
$= AB'(CD' + C'D) + A'B(CD' + C'D)$

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

$= (A \oplus B)(C \oplus D)$

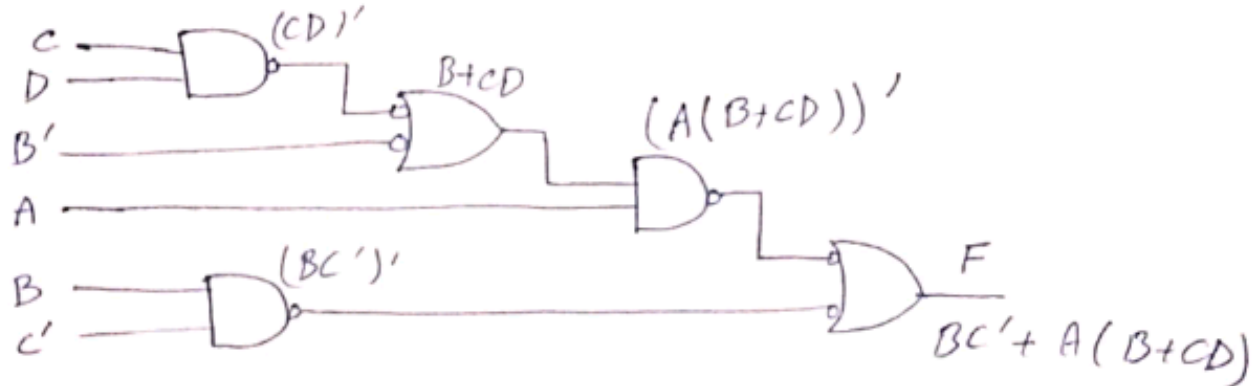
(3.32)

a) Fig 3.20 (a)
write equation (boolean)



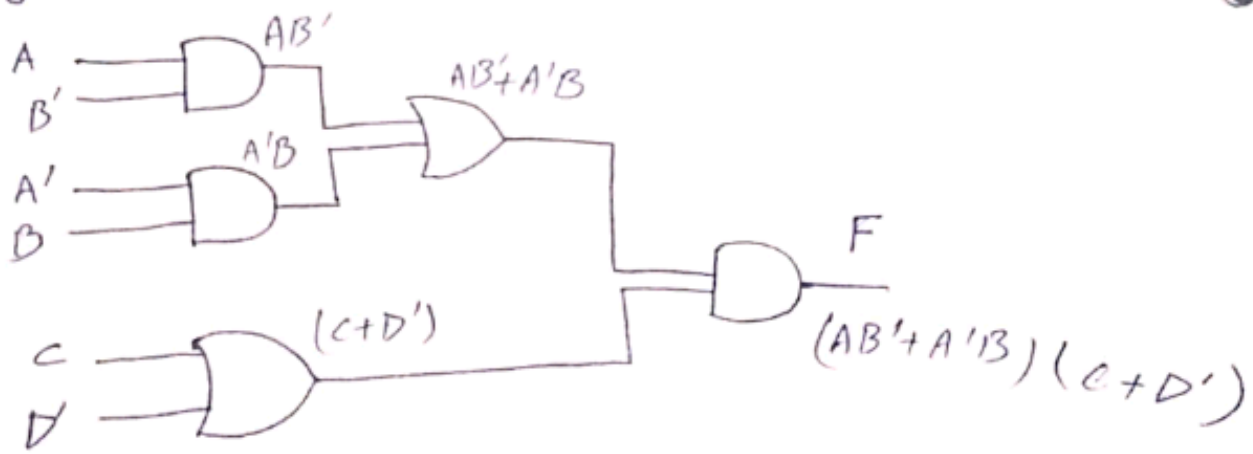
Boolean Expression: $BC' + A(B+CD)$

b) Fig 3.20 (b)



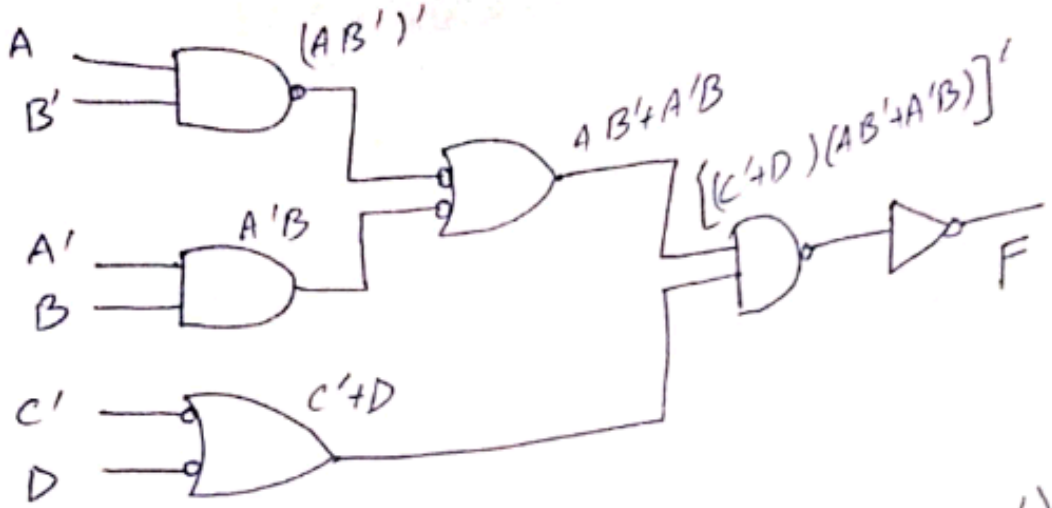
Boolean Expression: $BC' + A(B+CD)$

c) Fig 3.21 (a)



Boolean Expression: $(AB' + A'B)(C+D')$

d) Fig 3.21 (b)



Boolean expression: $(AB'+A'B)(C+D')$

e) Fig 3.24

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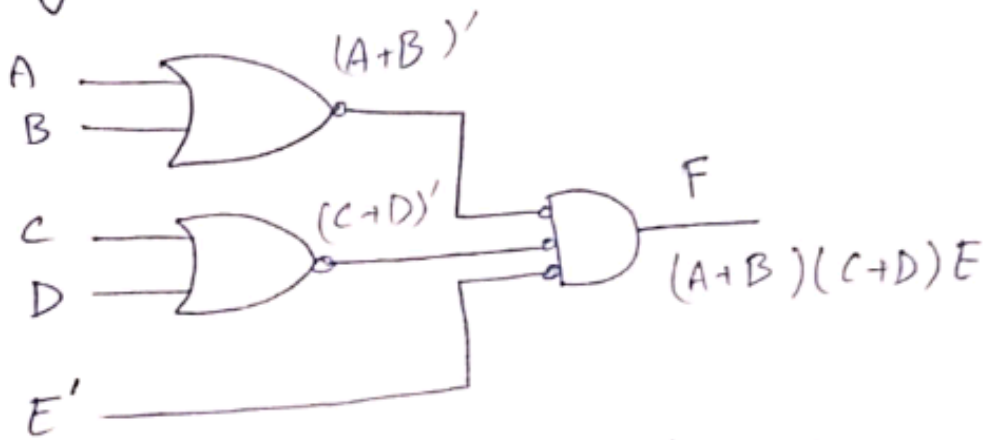
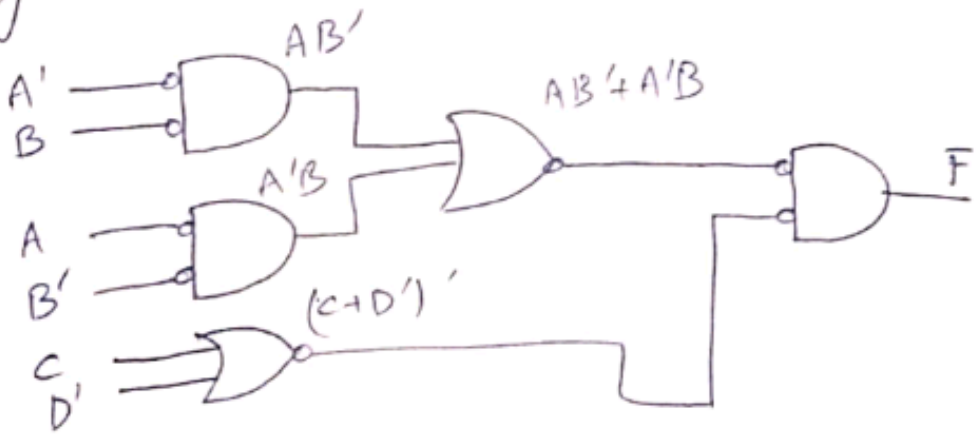


Boolean Expression: $(A+B)(C+D)E$

f) Fig 3.25

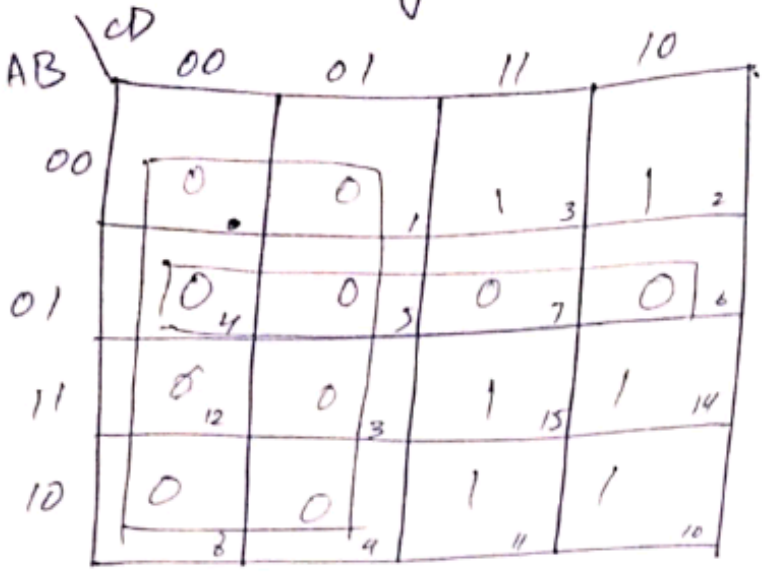


Boolean Expression: $(AB'+A'B)(C+D')$

3.34

a) $(A+B')\,C'(C+D)$

Simplify using K-map



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$= C'(A+B')$

b) $(C'D + BCD + CD')(A'+B)$

$= A'C'D + A'BCD + A'CD' + BC'D + BCD + BCD'$

$\Rightarrow BD + A'C'D + A'CD'$

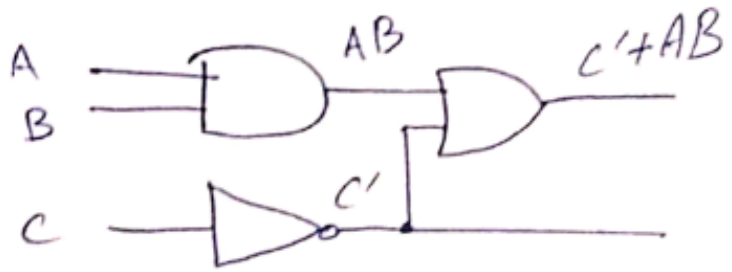
c) $(AB + C)D + B'C$

$ABD + CD + B'C$

Already simplified

(3.40)

Write Equation from Logic diagram



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Boolean Expression: $C' + AB$