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Subject: موضوع الدرس:

K. map

2 Variable → 2^2 → 4 Prob.

Truth table

	A	B	f
0 →	0	0	1
1 →	0	1	1
2 →	1	0	0
3 →	1	1	0

$f = \sum m(0,1)$, $f = \prod(2,3)$

$= A'B' + A'B$

$= A'(\cancel{B' + B})$ 1

$= A'$

K.map For 2 Var. → 4 Prob.

B \ A	A' 0	A 1
B' 0	(0) 1	(2) 0
B 1	(1) 1	(3) 0

$f = A'$

B \ A	A'	A
B'	(0) 1	(2) 1
B	(1) 0	(3) 1

$f = B' + A$

B \ A	A'	A
B'	(0) 1	(2) 0
B	(1) 0	(3) 1

$f = A'B' + AB$

$f = B' + AB$

$= B' + A$

A, B, C, D
W, X, Y, Z

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3 variable ⇒ 2^3 → 8 Prob. → 0 : 7

A, B, C $\qquad f = \Sigma m(0, 1, 4, 5, 6, 7)$

AB \ C	A'B'	A'B	AB	AB'
C'	0: 1	2:	6: 1	4: 1
C	1: 1	3:	7: 1	5: 1

↳ $f = A + B'$

$f = \Sigma m(0, 3, 6, 7)$

AB \ C	A'B'	A'B	AB	AB'
C'	0: 1	2:	6: 1	4:
C	1:	3: 1	7: 1	5:

↳ $f = A'B'C' + BC + AB$

* 4 Variables → 2^4 → 16 Prob. → 0 : 15

YZ \ WX	W'X'	W'X	WX	WX'
Y'Z'	0: 1	4: 0	12: 1	8: 1
Y'Z	1: 0	5: 1	13: 1	9: 0
YZ	3: 0	7: 1	15: 1	11: 0
YZ'	2: 1	6: 0	14: 1	10: 1

↳ $f = X'Z' + XZ + WX / WZ'$ ← SoP

↳ $f_1 = X'Z' + XZ + WX$

↳ $f_2 = X'Z' + XZ + WZ'$

شكل المعادلة (1)

EX: Simplify: $f(a,b,c,d) = \sum m(0,3,7,11,12,13,15)$ to the minimum SoP & PoS:

$cd \backslash ab$	$a'b'$	$a'b$	ab	ab'
$c'd'$	0: 1	4: 0	12: 1	8: 0
$c'd$	1: 0	5: 0	13: 1	9: 0
cd	3: 1	7: 1	15: 1	11: 1
cd'	2: 0	6: 0	14: 0	10: 0

$a'b'c'd'$ abc' cd c'

SoP: $f_1 = cd + abc' + a'b'c'd'$

* in PoS

$f' = cd' + a'bc' + b'c'd + ab'c' / ab'd'$

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

f

$f_2 = (c'+d)(a+b'+c)(b+c+d')(a'+b+c)$

$f_3 = (c'+d)(a+b'+c)(b+c+d')(a'+b+d)$

16, 8, 4, 2, 1

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Subject: شكل المعادلة (x) أصفار موضوع الدرس:

EX:

* Simplify: $f(A,B,C,D) = \Pi(1,3,5,7,13,15)$

To the minimum SOP & the minimum POS:-

4 var. → A, B, C, D.

AB \ CD	$A'B'$	$A'B$	AB	AB'
$C'D'$	0: 1	4: 1	12: 1	8: 1
$C'D$	1: 0	5: 0	13: 0	9: 1
CD	3: 0	7: 0	15: 0	11: 1
CD'	2: 1	6: 1	14: 1	10: 1

D', C', D, C, A', B, A, B'

* The minimum SOP:-

$f = D' + AB'$

$f = D' + AB'D = (D' + AB')\cancel{(D' + D)}$ 1

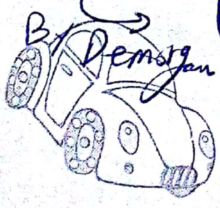
* the minimum POS:

$f' = A'D + BD$

$(f')' = (A'D + BD)'$

By Demorgan

$f = (A + D')(B' + D')$.



Ex:

شكل المعادلة (3)

SoP → لأن

Simplify:

$$F(A,B,C,D) = \underline{ACD'} + C'D + AB' + ABCD$$

To the minimum SoP form & PoS form.

$CD \backslash AB$	$A'B'$	$A'B$	AB	AB'
$C'D'$	0 (0)	0 (4)	0 (12)	1 (8)
$C'D$	1 (1)	1 (5)	1 (13)	1 (9)
CD	0 (3)	0 (7)	1 (15)	1 (11)
CD'	0 (2)	0 (6)	1 (14)	1 (10)

* **SoP:** 1's

$$\hookrightarrow f = C'D + AB' + AC$$

* **PoS:** → 0's

$$\hookrightarrow f' = A'C + A'D' + BC'D'$$

$$\hookrightarrow (f')' = (A'C + A'D' + BC'D')'$$

$$\hookrightarrow f = (A + C')(A + D)(B' + C + D)$$

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Ex: Simplify:-

تكمل المعادلة رقم (٤)

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

PoS $(B' + C + D')$ → To SoP & PoS.

ANS.

$f' = AB'D + ABC + ABC' + BCD$

ركز

$CD \backslash AB$	$A'B'$	$A'B$	AB	AB'
$C'D'$	0: 1	4: 1	12: 0	8: 1
$C'D$	1: 1	5: 1	13: 0	9: 0
CD	3: 1	7: 0	15: 0	11: 0
CD'	2: 1	6: 1	14: 0	10: 1

* SoP:

$f = A'B' + A'C' + B'D' + A'CD'$

* PoS:

$f' = AB + AD + BCD$

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

f in PoS.

(1) $\Rightarrow f = \sum m(\_\_, \ldots)$ ↲ $\boxed{1's}$ on K.map

(2) $\Rightarrow f = \prod(\ldots)$ ↲ $\boxed{0's}$ on K.map.

(3) $\Rightarrow f = \_\_ + \_\_ + \_\_ + \_\_$

$\boxed{1's}$ on K.map.

(4) $\Rightarrow f = (\ + \ + \ )(\ + \ + \ )(\ + \ + \ )$

↳ $f' = \_\_ + \_\_ + \_\_$

↳ $\boxed{0's}$ on K.map.

⇒ Find the minterms of the following Boolean expressions by first plotting each fun. in a map, then simplify them.

$f = \ldots$

⇒ Simplify the following fun. to SOP or POS

⇒ Convert the following boolean function from SOP form to a simplified POS form.

$f = \_\_ + \_\_ + \_\_$

K.map with don't Cares.

Ex 1)

Simplify: $F(x,y,z) = \Sigma(0,1,4,5,6) \rightarrow 1\text{'s}$

$d(x,y,z) = \Sigma(2,3,7) \rightarrow X$

$z \backslash xy$	$x'y'$	$x'y$	xy	xy'
z'	0: 1	2: X	6: 1	4: 1
z	1: 1	3: X	7: X	5: 1

$\rightarrow F = 1$

Ex 2)

Simplify: $F(A,B,C,D) = \Sigma(2,4,7,10,12)$

$d(A,B,C,D) = \Sigma(0,6,8)$

to SOP form

$CD \backslash AB$	$A'B'$	$A'B$	AB	AB'
$C'D'$	0: X	4: 1	12: 1	8: X
$C'D$	1	5	13	9
CD	3	7: 1	15	11
CD'	2: 1	6: X	14	10: 1

$\rightarrow F = C'D' + B'D' + A'BC$

SOP

to POS form

$CD \backslash AB$	$A'B'$	$A'B$	AB	AB'
$C'D'$	X			X
$C'D$	0	0	0	0
CD	0		0	0
CD'		X	0	

$\rightarrow F' = C'D + B'D + ABC$

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

Ex 3:

Simplify:

$$F(w,x,y,z) = \Sigma m(4,6,11,12,13) + \Sigma d(3,5,7,9,10)$$

$yz \backslash wx$	$w'x'$	$w'x$	wx	wx'
$y'z'$	0:	4: 1	12: 1	8:
$y'z$	1:	5: X	13: 1	9: X
yz	3: X	7: X	15:	11: 1
yz'	2:	6: 1	14:	10: X

SOP

$$F = w'x + xy' + wx'z \;/\; wx'y \;/\; x'yz$$

$$f_1 = w'x + xy' + wx'z$$

$$f_2 = w'x + xy' + wx'y$$

$$f_3 = w'x + xy' + x'yz$$

$yz \backslash wx$	$w'x'$	$w'x$	wx	wx'
$y'z'$	0			0
$y'z$	0	X		X
yz	X	X	0	
yz'	0		0	X

POS

$$f' = w'x' + x'y' + wxy$$

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

* two level NAND must be SoP.
* two level NOR must be PoS

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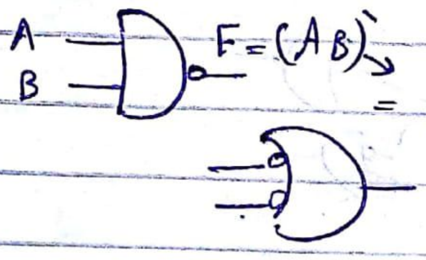
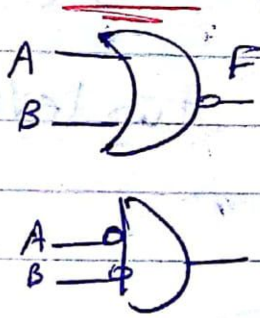
* logic Diagrams :

NAND:



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

NOR:



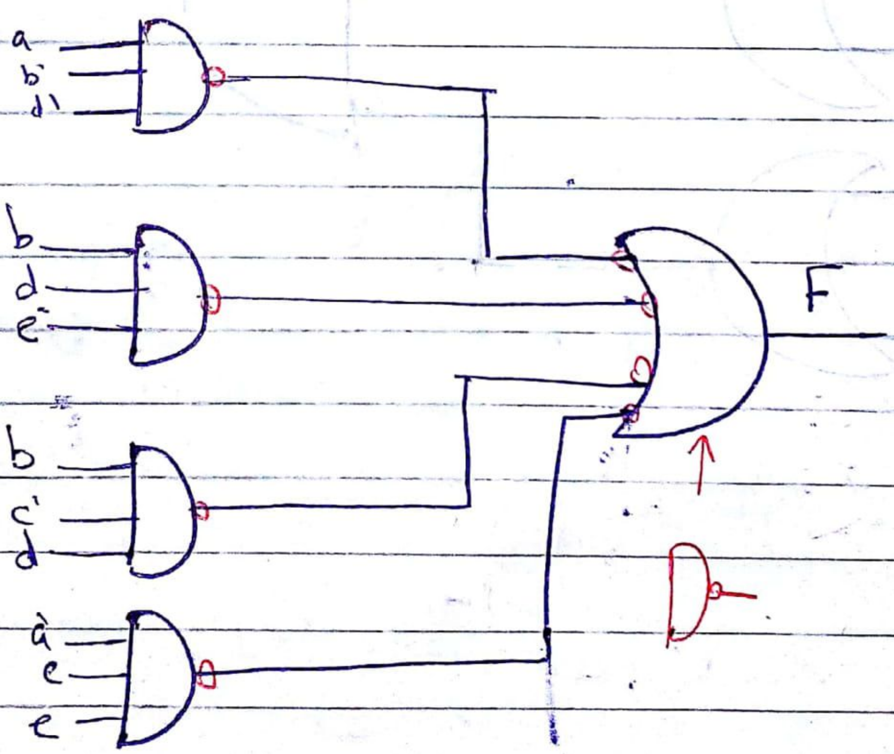
$F = (A+B)' \rightarrow A'B'$

EX1 :

↳ show the block diagram of :

$$F = ab'd' + bde' + bc'd + a'ce$$

by using two level NAND

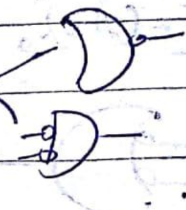


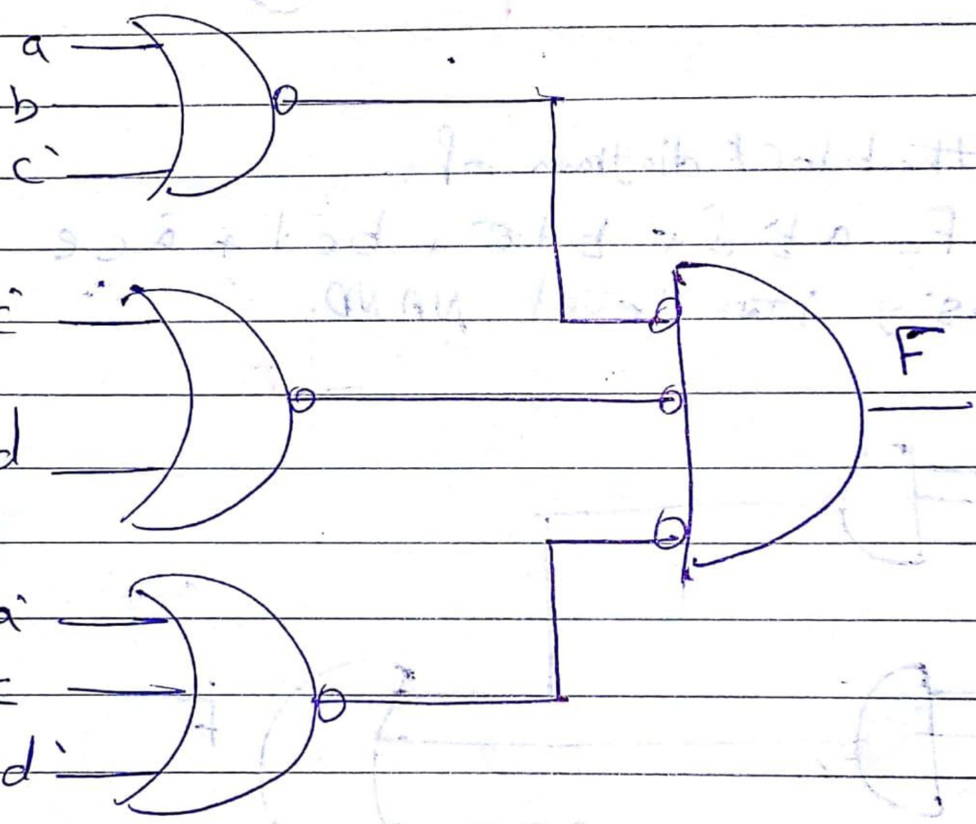
Ex2

↳ Show the block diagram of :-

$F = (a + b + \bar{c})(\bar{c} + d)(\bar{a} + c + \bar{d})$ ← PoS.

↳ by using Two level NOR





Date: / / $b \text{—}\!\triangleright\!\circ\; b'$ (All Variable available a, a', b, b') / / :التاريخ

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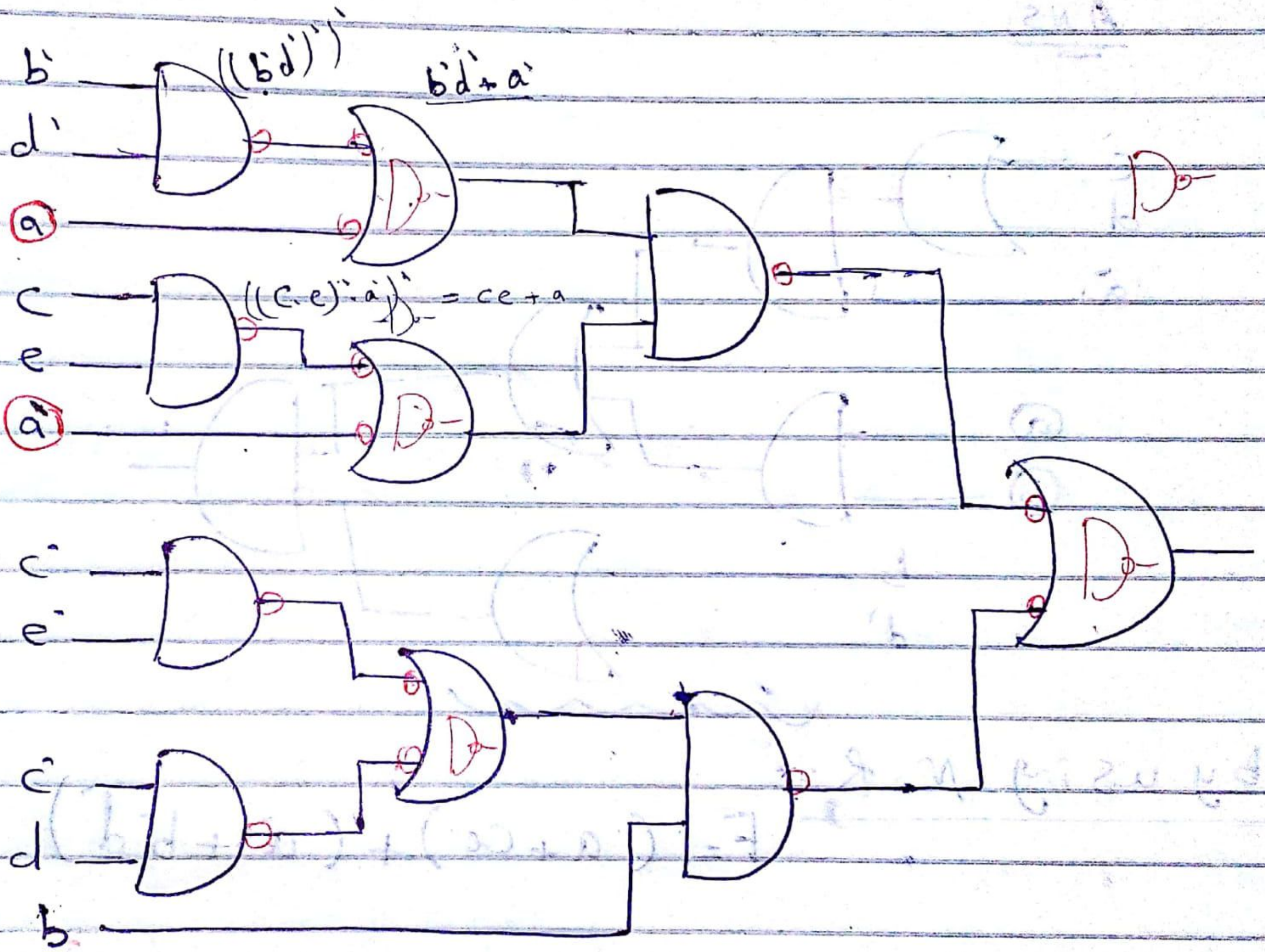
EX 3:

Show the block diagram of :

$$F = b(c'd + c'e') + (a + ce)\cdot(a' + b'd')$$

using Multilevel NAND.



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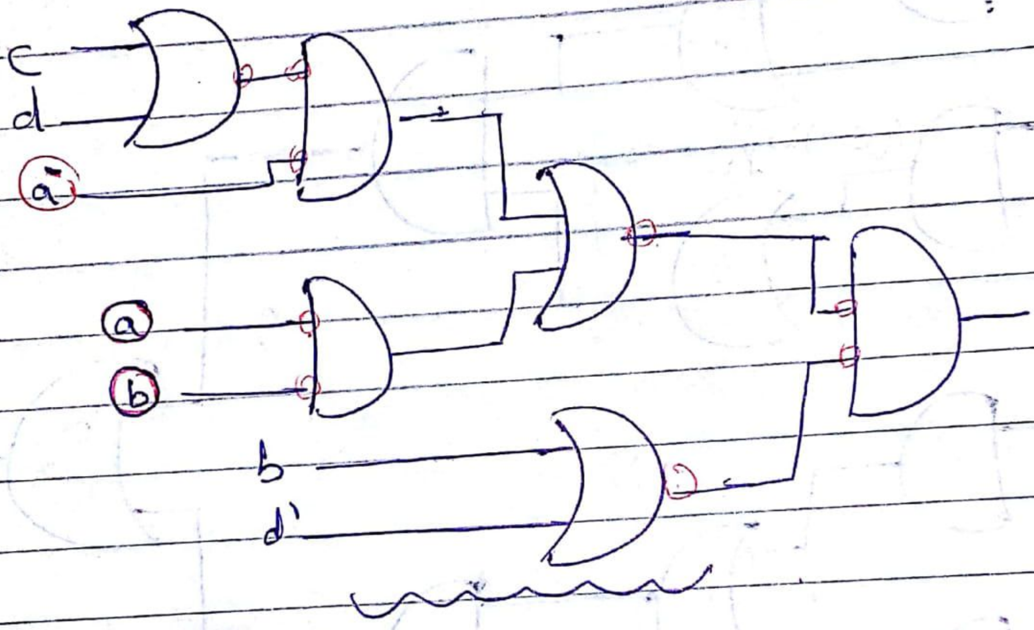
EX4:

by using multi level NOR:

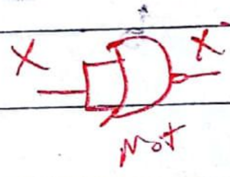
$$F = [a'b' + a(c+d)] \cdot (b + d')$$

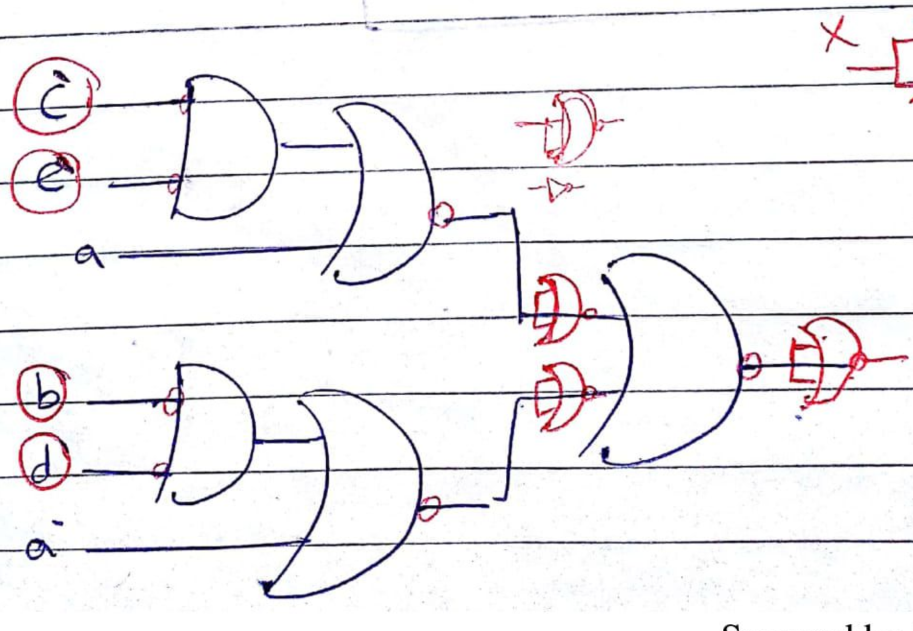
ANS:



by using NOR:

$$F = (a + ce) + (a' + b'd')$$





EX:

Given the function, (assume all variables are avaliable both complemented and un complemented)

$$F = a'b' + a'c + ab'$$

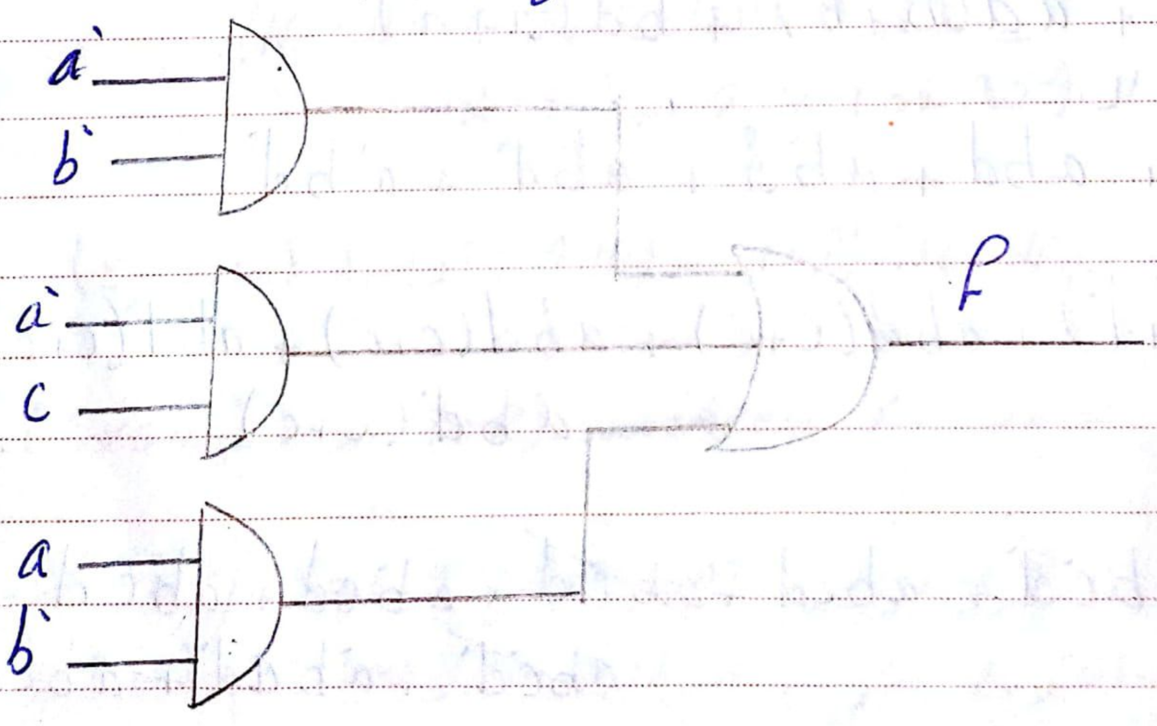
a) Show a block diagram for a two level implementation of F using AND and OR gates.

b) show a block diagram for an implementation of F using only NAND gates.

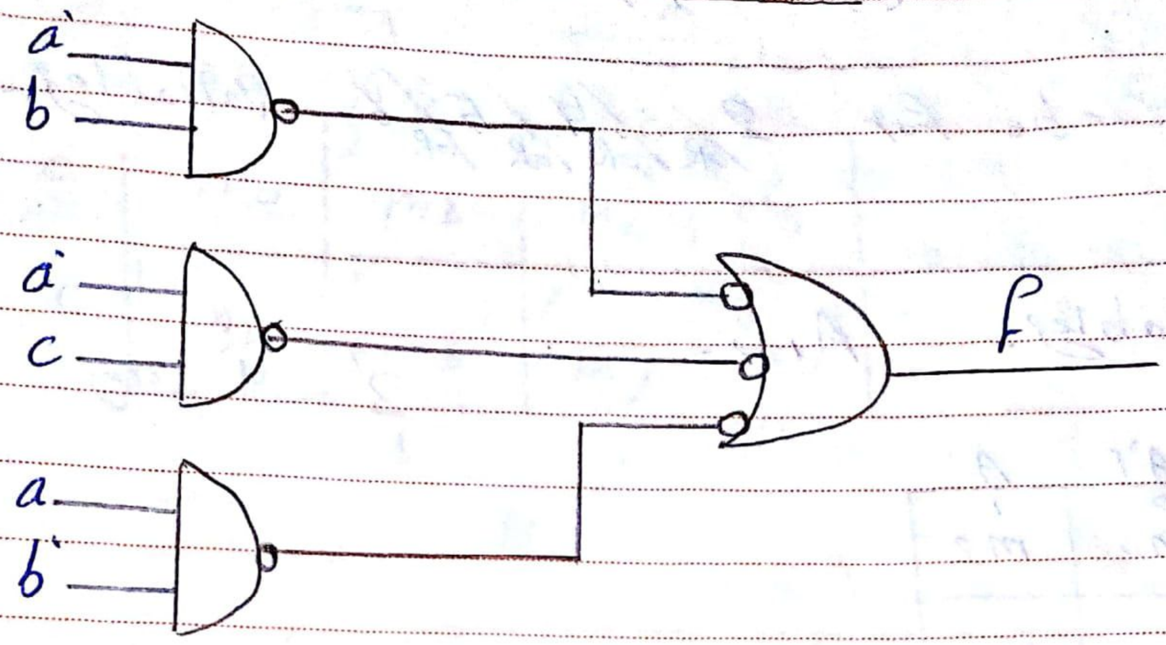
c) Expand F to sum of minterms, eliminate any duplication.

Solutions:

a) The Block diagram by AND, OR.



b) The Block diagram by NAND ::



c) The EXPanding of $f = a'b' + a'c + ab'$

$(a, b, c$

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

$$= a'b'c + a'b'c' + a'bc + \cancel{a'b'c} + ab'c + ab'c'$$

$$= a'b'c + a'b'c' + a'bc + ab'c + ab'c'$$