Exercise 02

الاسم :

2.1 (a) Prove that $(x+y+z)' = x'y'z'$
and $(xyz)' = x'+y'+z'$

1- $(x+y+z)'$

x	y	z	$x+y+z$	$(x+y+z)'$	x'	y'	z'	$x'y'z'$
0	0	0	0	1	1	1	1	1
0	0	1	1	0	1	1	0	0
0	1	0	1	0	1	0	1	0
0	1	1	1	0	1	0	0	0
1	0	0	1	0	0	1	1	0
1	0	1	1	0	0	1	0	0
1	1	0	1	0	0	0	1	0
1	1	1	1	0	0	0	0	0

Then $(x+y+z)' = x'y'z'$ I

x	y	z	xyz	$(xyz)'$	x'	y'	z'	$x'+y'+z'$
0	0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0	1
0	1	0	0	1	1	0	1	1
0	1	1	0	1	1	0	0	1
1	0	0	0	1	0	1	1	1
1	0	1	0	1	0	1	0	1
1	1	0	0	1	0	0	1	1
1	1	1	1	0	0	0	0	0

then $(xyz)' = x'+y'+z'$ II

(e) The associative Law $x(yz) = (xy)z$

x	y	z	yz	x(yz)	xy	(xy)z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	1	0	0	0
1	0	0	0	0	0	0
1	0	1	0	0	0	0
1	1	0	0	0	1	0
1	1	1	1	1	1	1

then $x(yz) = (xy)z$ #

2.2 : Simplify the following Boolean expression:-

(f) $a'bc + abc' + abc + a'bc'$

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

$= a'b \cdot 1 + ab \cdot 1$ Complement

$= a'b + ab$

$= b(a' + a)$ distributive

$= b \cdot 1$ Complement

$= b$ #

2.3 - Simplify the following Boolean exp

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

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

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

$= 0 + a'b' + a'c' + ac' + b'c' + c$

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

$= a'b' + c' \cdot 1 + c'$

$= a'b' + c'$ #

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2.4 - Reduce the following

(a) $A'C' + ABC + AC'$ (to three literals)

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

$= C' \cdot 1 + ABC$

$= C' + (ABC)$

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

$= (A+C')(B+C') \cdot 1$

$= C' + AB$

$= AB + C'$ #

(d) $(A'+C)(A'+C')(A+B+C'D)$ (four Literals)

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

$= A' + 0 \ (A+B+C'D)$

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

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

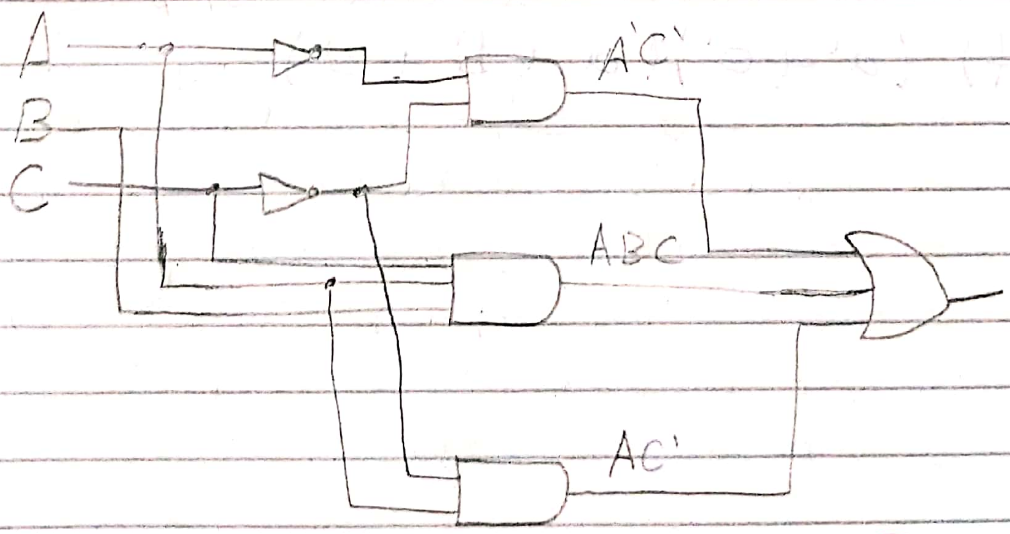
$= 0 + A'B + A'C'D$

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

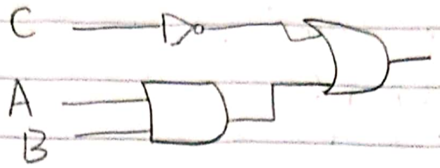
$= A'(B+C'D)$ #

2.7 - Draw the logic digram of the circuits that implement the original & simplified expression in Problem 2.4?

(a) Original $= A'C' + ABC + AC'$



(b) Simplified $= AB + C'$



2.8- Find the Complement of

$F = WX + YZ$;

$F' = (WX + YZ)'$

$= (WX)'(YZ)'$

$= (W' + X')(Y' + Z')$ #

Show that $FF' = 0$

$FF' = (WX + YZ)[(W' + X')(Y' + Z')]$

$= WX(W' + X')(Y' + Z') + YZ(W' + X')(Y' + Z')$

$= (WXW' + WXX')(WXY' + WXZ') + YZ(W' + X')(Y' + Z')$

$= 0\,(WXY' + WXZ') + (YZW' + YZX')(YZY' + YZZ')$

$= 0\,(WXY' + WXZ') + (YZW' + YZX')\,0$

$\because X . 0 = 0$

$\therefore 0 + 0 = 0$ # $\boxed{F . F' = 0}$

$F + F' = 1$

$F + F' = (WX + YZ) + [(W' + X')(Y' + Z')]$

$= [(WX + YZ) + (W' + X')][(WX + YZ) + (Y' + Z')]$

$= [(WX + X') + YZ + W'][(YZ + Z') + WX + Y']$

$= [W + X' + YZ + W'][Y + Z' + WX + Y']$

$= [(W + W') + X' + YZ][(Y + Y') + Z' + WX]$

$= [1 + X' + YZ][1 + Z' + WX]$

$= 1 . 1$

$= \boxed{1}$

$\therefore F + F' = \boxed{1}$

2.4. Find the Complement of

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

$= [(a+c)(a+b')(a'+b+c')]'$

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

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

2.12. Perform AND operation:-

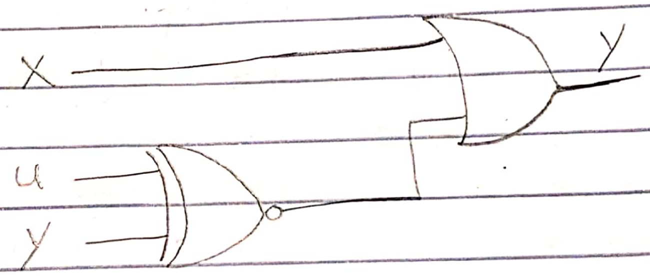
A = 10110001

B = 10101100

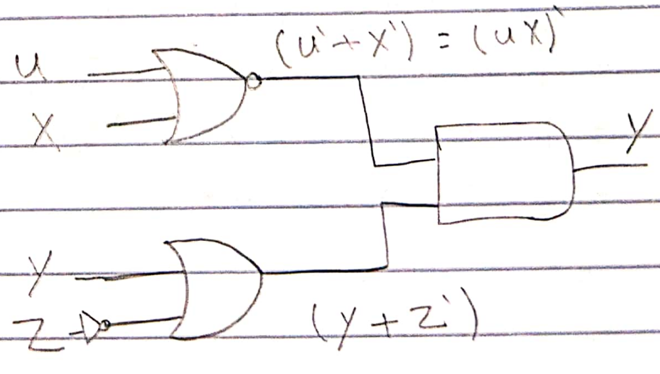
$\boxed{10100000}$

2.13. Draw logical diagram

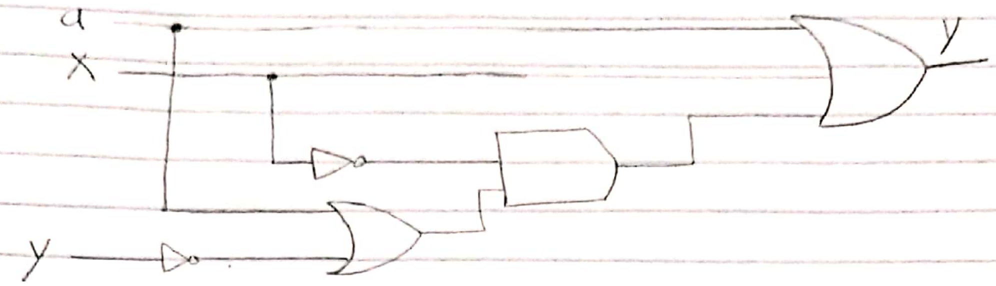
(b) $y = (u \oplus y)' + x$



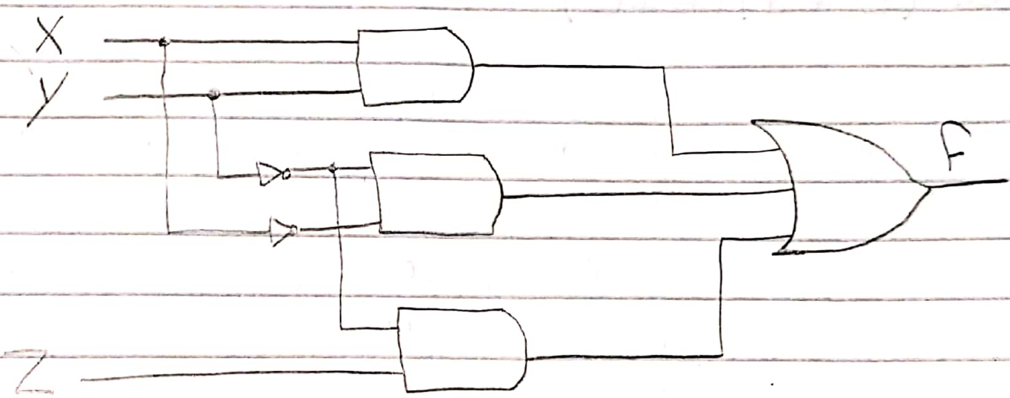
(c) $y = (u' + x')(y + z')$



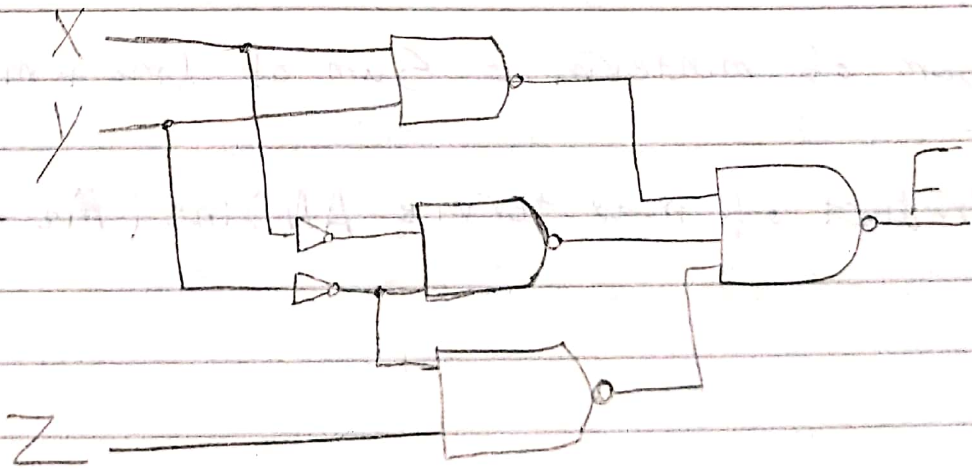
(f) $y = u + x + x'(u + y')$
$= u + x + x'u + x'y'$



2.14 - Implement the Boolean function
$F = xy + x'y' + y'z$
(a) with AND, OR, and inverter gates :-

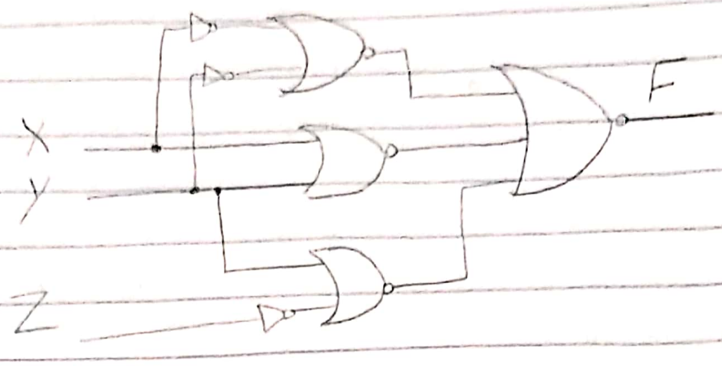


(b) With NAND and inverter gates.
$F = xy + x'y' + y'z$



(e) with NOR and inverter gates:-

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



2.17- Obtain the truth table, and express each function in SOMin and Pomax :-

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

b	c	d	c'	c'+d	b+c'	(c'+d)(b+c')	
0	0	0	1	1	1	1	m_0
0	0	1	1	1	1	1	m_1
0	1	0	0	0	0	0	m_2
0	1	1	0	1	0	0	m_3
1	0	0	1	1	1	1	m_4
1	0	1	1	1	1	1	m_5
1	1	0	0	0	1	0	m_6
1	1	1	0	1	1	1	m_7

1- Sum of minterm = Sum of $(m_0 + m_1 + m_4 + m_5 + m_7)$

$= b'c'd' + b'c'd + bc'd' + bc'd + bcd$ I

2- Product of max terms ANDing $(M_2 \cdot M_3 \cdot M_6)$

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

(d) $bd' + acd' + ab'c + a'c'$

a	b	c	d	bd'	acd'	$ab'c$	$a'c'$	ORing	=
0	0	0	0	0	0	0	1	1	M_0
0	0	0	1	0	0	0	1	1	M_1
0	0	1	0	0	0	0	0	0	M_2
0	0	1	1	0	0	0	0	0	M_3
0	1	0	0	1	0	0	1	1	M_4
0	1	0	1	0	0	0	1	1	M_5
0	1	1	0	1	0	0	0	1	M_6
0	1	1	1	0	0	0	0	0	M_7
1	0	0	0	0	0	0	0	0	M_8
1	0	0	1	0	0	0	0	0	M_9
1	0	1	0	0	1	1	0	1	M_{10}
1	0	1	1	0	0	1	0	1	M_{11}
1	1	0	0	1	0	0	0	1	M_{12}
1	1	0	1	0	0	0	0	0	M_{13}
1	1	1	0	1	1	0	0	1	M_{14}
1	1	1	1	0	0	0	0	0	M_{15}

$F = \text{ANDing}\ (2, 3, 7, 8, 9, 13, 15)$

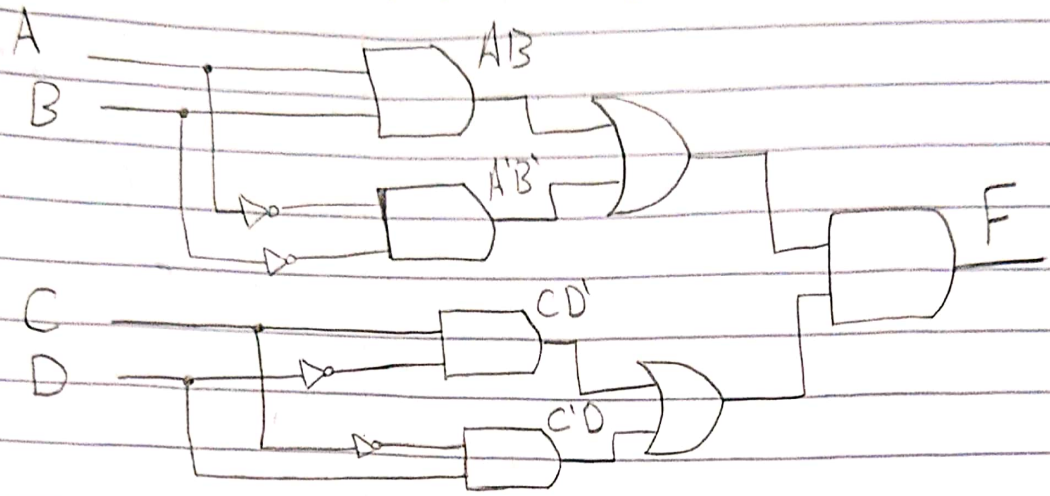
$= M_2 . M_3 . M_7 . M_8 . M_9 . M_{13} . M_{15}$

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

$F = \text{ORing}\ (0, 1, 4, 5, 6, 10, 11, 12, 14)$

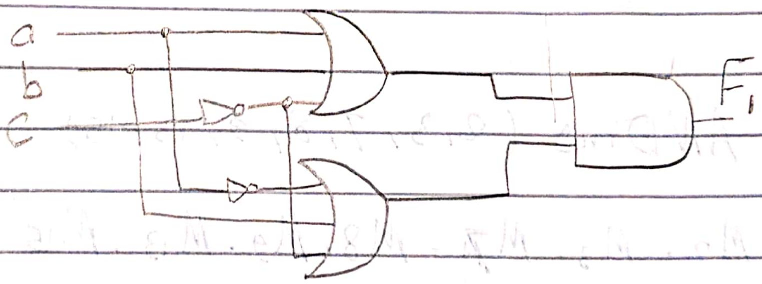
2.23- Draw The logic diagram:-

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

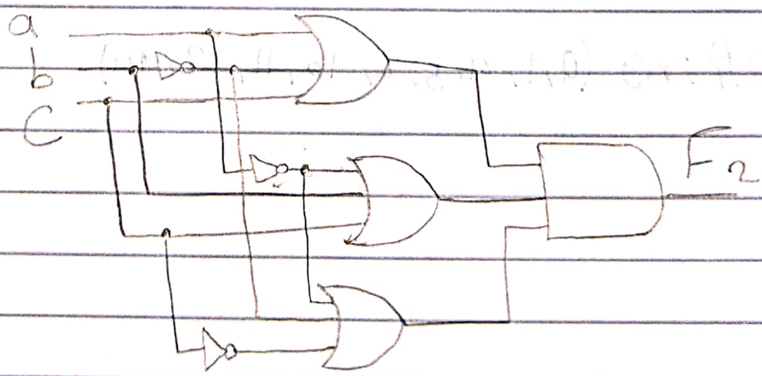


2.27- Write the Boolean equations and Draw the Logic diagram :-

F_1 = ANDing of $(M_1 \cdot M_5)$
$= (a+b+c')(a'+b+c')$



F_2 = ANDing of $(M_2 \cdot M_4 \cdot M_6)$
$= (a+b'+c)(a'+b+c)(a'+b'+c')$



2.28- Write the Boolean expression & the truth table :-

(a) $y = [(ae(bcd)')']'$

(b) $y_1 = (a \oplus (c+d+e))$

$y_2 = [b'f(c+d+e)]'$