Assignment - 02

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Course Title : Digital Logic Design

Course Code : CSE260

Section : 05

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Ans. to the Q. NO - 01

Given,

$$(A+B)(A+B)(A+C)$$

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

$$= A\cdot A + A\cdot C + B\cdot A + B\cdot C$$

$$= A + AC + BA + BC \quad [\because AA = A]$$

$$= A + AB + BC \quad \left[\begin{array}{l}\because \text{Absorption Law,} \\ A + AC = A\end{array}\right]$$

$$= A + BC$$

$$\therefore (A+B)(A+B)(A+C) = A+BC$$

(Ans:)

Answer to the Q. NO - 02

Given expression:-

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

$=(x' \cdot y \cdot z') + (x' \cdot y') + (x \cdot z')$

$= (x \cdot y' \cdot z) + (x \cdot y) + (x'z)$

(Ans:)

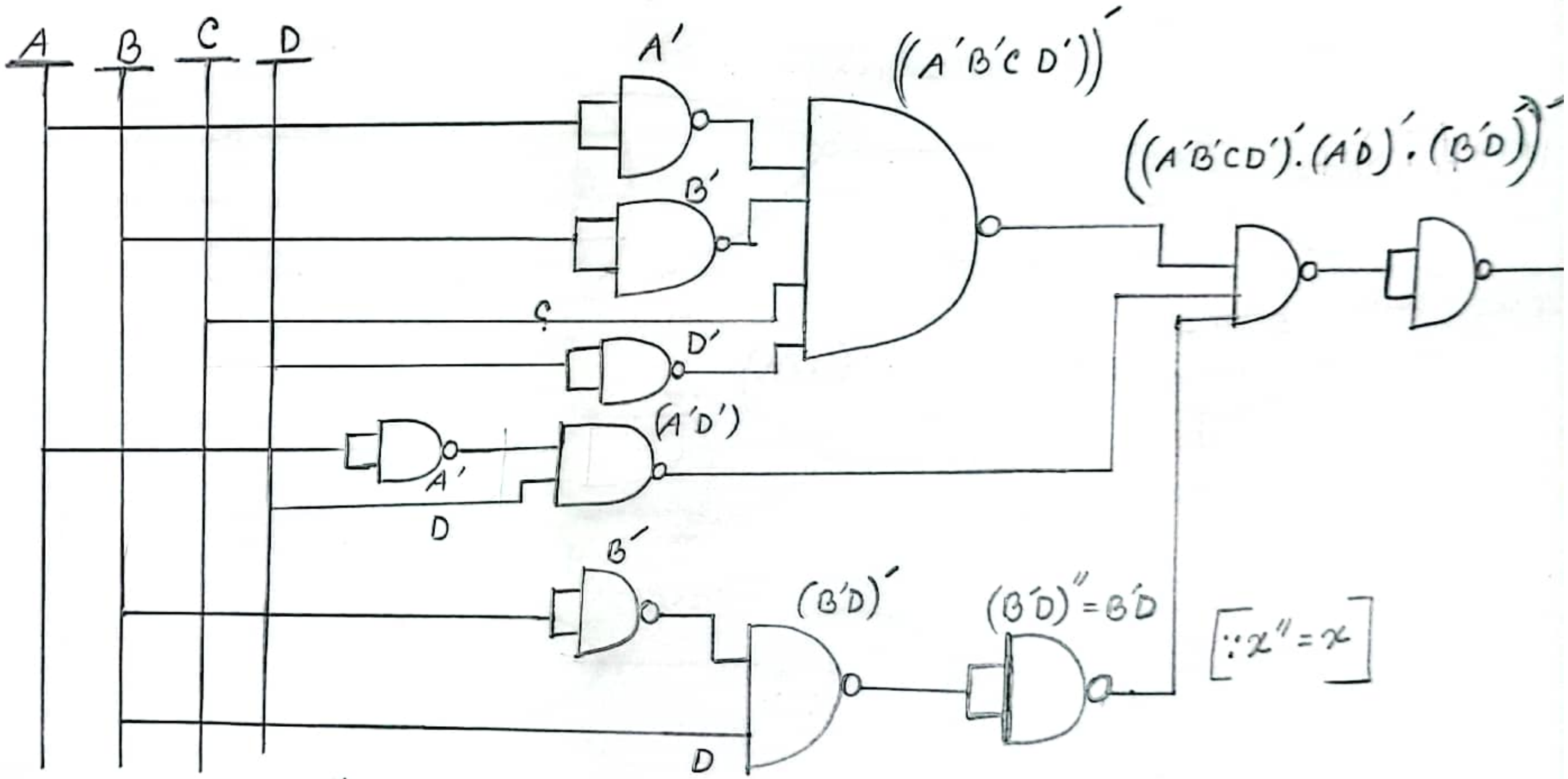
[P.T.O.]

Answer to the Q. NO-03

Given,

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

Drawing using NAND Gates only:-



We can write from the above,

$$((A'B'CD')\cdot(A'D')\cdot(B'D)')' = (A'B'CD')'' + (A'D'') + (B'D)'' \quad [\because (xy)' = x'+y']$$

$$= A'B'CD' + A'D + B'D \quad [\because x'' = x]$$

(Ans:)

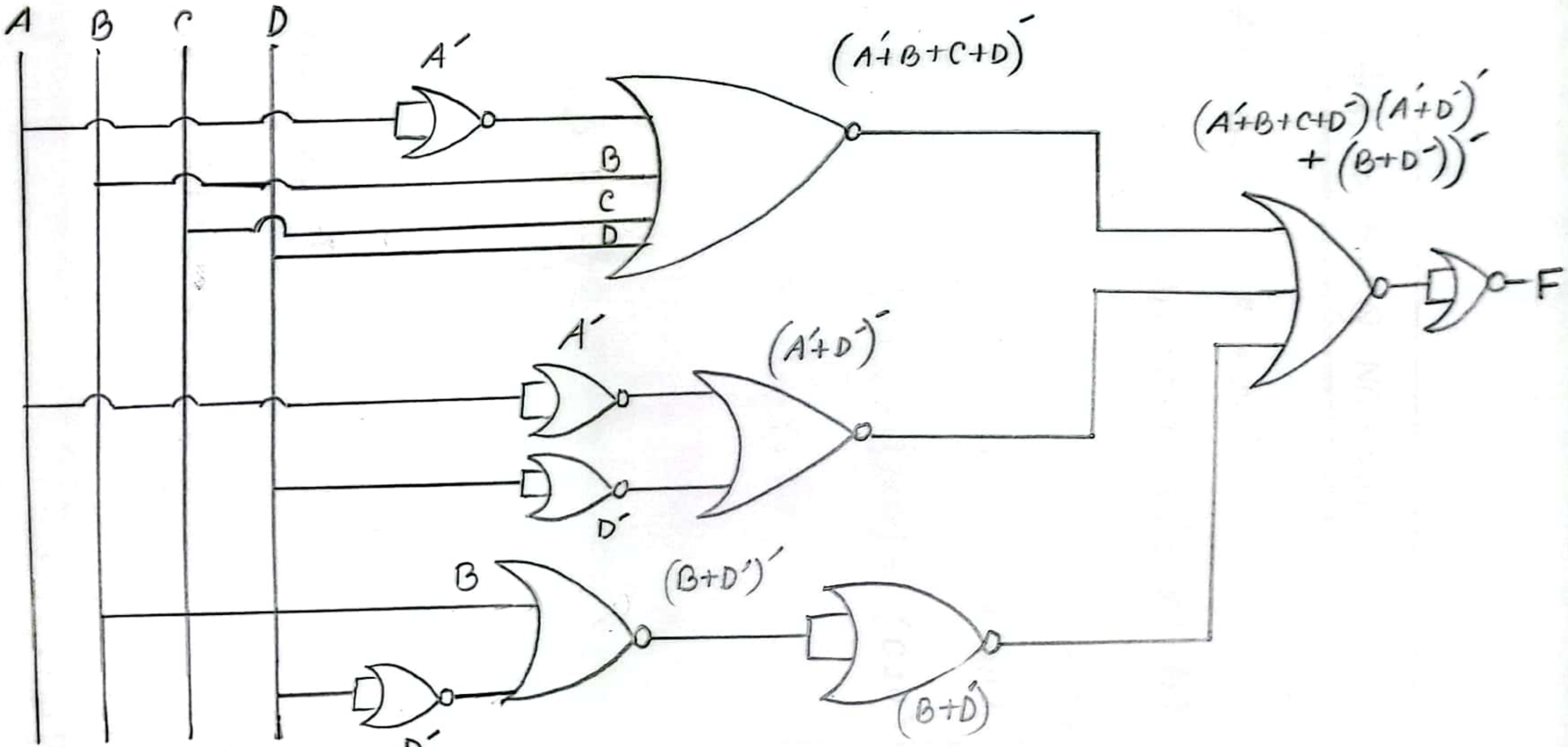
[P.T.O.]

Answer to the Q. NO - 04

Given,

$$F(A,B,C,D) = \left(AB'C'D' + AD + (B+D')\right)$$

drawing using NOR Gates only:-



We can write from the above,

$$(A'+B+C+D')' + (A'+D')' + (B+D') = A\cdot B'C'D' + AD + (B+D')$$

$$= A\cdot B'C'D' + AD + \left(B+D'\right) \quad \text{(Ans:)}$$

[P.T.O]

Ans. to the Q. NO - 05(a)

Given,

SOP $F(A,B,C) = AB + BC'$

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

$= ABC + ABC' + ABC' + A'BC'$

$= ABC + ABC' + A'BC'$

$= (111) + (110) + (010)$

$= \Sigma(7, 6, 2)$

SOP, $x = 1$ $x' = 0$

POS $AB + BC'$

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

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

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

$= (A+B+CC')(AA'+B+CC')(A+BB'+C')(AA'+B+C')$

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

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

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

[P.T.O.]

$$\Rightarrow (A+B+C)(A+B+C')(A+B+C)(A'+B+C)(A+B+C')$$
$$(A'+B+C')(A+C'B)(A+C'+B')(B+C'+A)(B+C'+A')$$

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

000   001   100   101   011

POS,
$x=0$
$x'=1$

$$= \pi(0,1,4,5,3)$$

$$\therefore F(A,B,C) = AB + BC' \Rightarrow SOP = \Sigma(7,6,2)$$
$$\Rightarrow POS = \pi(0,1,4,5,3)$$

(Ans:)

Ans. to the Q. NO - 05(b)

SOP

Given,

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

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

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

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

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

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

$$= 1111 + 1110 + 1101 + 1100 + 1011 + 1010 + 1001 + 1000 + 0010$$

$$= \Sigma(15, 14, 13, 12, 11, 10, 9, 8, 2)$$

[P.T.O.]

POS

Given,

$A + B'CD'$

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

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

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

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

$= (0100)(0110)(0101)(0111)(0000)(0001)$
(0011)

$= \pi(4,6,5,7,0,1,3)$

$\therefore F(A,B,C,D) = SOP \Rightarrow \Sigma(15,14,13,12,11,10,9,8,2)$
$= POS \Rightarrow \pi(4,6,5,7,0,1,3)$ (Ans:)

Ans. to the Q. NO - 05(c)

Sol
Given,

$$F(A,B,C,D,E) = AB + CDE$$

$$= AB(C+C')(D+D')(E+E') + (A+A')(B+B') \cdot CDE$$

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

$$=(ABCD+ABCD'+ABC'D+ABC'D')(E+E') + (ABCDE + ABC'DE + A'BCDE + A'B'CDE)$$

$$= ABCDE + ABCDE' + ABCD'E + ABCD'E' + ABC'DE + ABC'DE' + ABC'D'E + ABC'D'E + ABCDE + AB'CDE + A'BCDE + A'B'CDE$$

$$= ABCDE + ABCDE' + ABCD'E + ABCD'E' + ABC'DE + ABC'DE' + ABC'D'E + ABC'D'E' + AB'CDE + A'BCDE + A'B'CDE$$

$$= (11111)(11110)(11101)(11100)(11011)(11010)(11001)(11000)(10111)(01111)(00111)$$

$$= \Sigma(31, 30, 29, 28, 27, 26, 25, 24, 23, 15, 17)$$

POS

$AB+CDE$

$=(AB+C)(AB+D)(AB+E)$

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

$=(A+BB'+C+DD'+EE')(AA'+B+C+DD'+EE')\cdot$

$(A+BB'+CC'+D+EE')(AA'+B+CC'+D+EE')\cdot$

$(A+BB'+CC'+DD'+E)(AA'+B+CC'+DD'+E)$

$=(A+BB'+C+DD'+E)(A+BB'+C+DD'+E')(AA'+B+C+DD'+E)$

$(AA'+B+C+DD'+E')(A+BB'+CC'+D+E)(A+BB'+CC'+D+E')\cdot$

$(AA'+B+CC'+D+E)(AA'+B+CC'+D+E')(A+BB'+CC'+D+E)$

$(A+BB'+CC'+D'+E)(AA'+B+CC'+D+E)(AA'+B+CC'+D'+E)$

$=(A+BB'+C+D+E)(A+BB'+C+D'+E)(A+BB'+C+D+E)\cdot$

$(A+BB'+C+D'+E')(AA'+B+C+D+E)(AA'+B+C+D'+E)\cdot$

$(AA'+B+C+D+E')(AA'+B+C+D'+E')(A+BB'+C+D+E)\cdot$

$(A+BB'+C'+D+E)(A+BB'+C+D+E')(A+BB'+C'+D+E')\cdot$

$(AA'+B+C+D+E)(AA'+B+C'+D+E)(AA'+B+C+D+E')$

$(AA'+B+C'+D+E')(A+BB'+C+D+E)(A+BB'+C'+D+E)\cdot$

$(AA'+B+C+D+E)(AA'+B+C'+D+E)$

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

$=(00000)\ (01000)\ (00010)\ (01010)\ (00001)$
$(01001)\ (00011)\ (01011)\ (10000)\ (10010)$
$(10001)\ (10011)\ (00100)\ (01100)\ (00111)$
$(01101)\ (10100)\ (10101)\ (00110)\ (10110)$

$=\pi(0,8,2,10,1,9,3,11,16,18,17,19,4,12,$
$13,20,21,6,22)$

(Ans:)

Ans. to the Q. NO - 06

Given,

$$F(a,b,c,d) = \Sigma(8, 9, 10, 11, 13, 15)$$

$$= (1000)\,(1001)\,(1010)\,(1011)\,(1101)\,(1111)$$

$$= ab'c'd' + ab'c'd + ab'cd' + ab'cd + abc'd + abcd$$

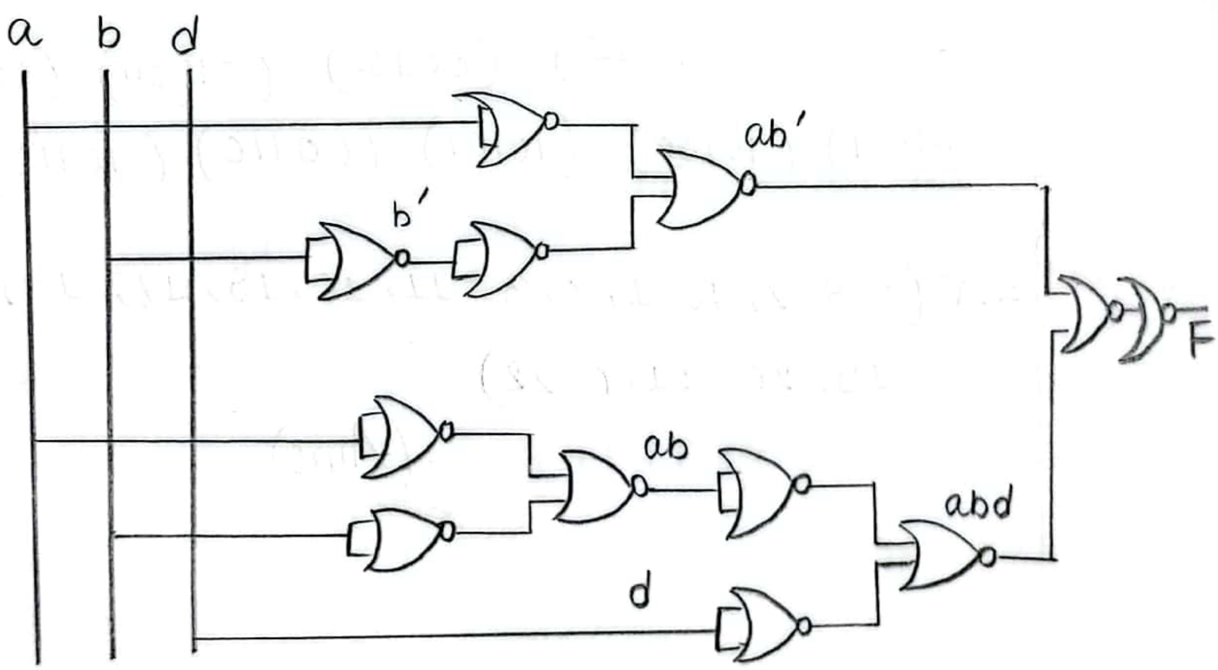
$$= ab'c'(d'+d) + ab'c\,(d'+d) + abd\,(c'+c)$$

$$= ab'c' + ab'c + abd$$

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

$$= ab' + abd$$

using only NOR Gates:



Ans. to the Q. NO- 07 (a)

Given,

$$F(a,b,c,d) = \sum(8,9,0,11,7,15)$$

$$= (1000)(1001)(0000)(1011)(0111)(1111)$$

$$= ab'c'd' + ab'c'd + a'b'c'd' + ab'cd + abcd$$

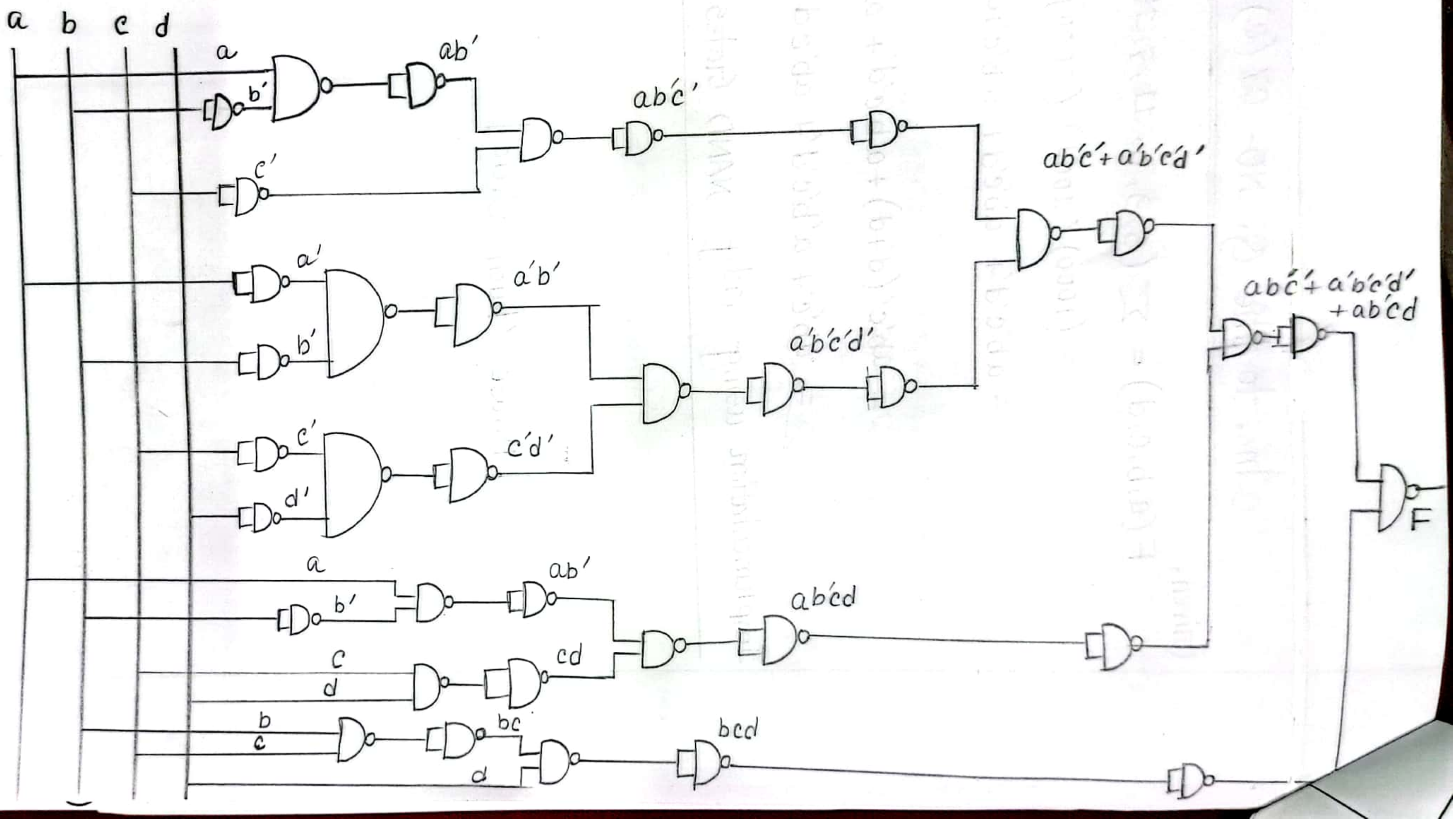
$$= ab'c'(d'+d) + a'b'c'd' + ab'cd + bcd(a+a')$$

$$= ab'c' + a'b'c'd' + ab'cd + bcd$$

Implementation using only NAND Gates:

[Please Turn Over]

$F = ab'c' + a'b'c'd' + ab'cd + bcd$



Ans. to the Q. NO - 07 (b)

Given,

$$F(a,b,c,d) = \Sigma(5,8,9,12,15)$$

$$= (0101)(1000)(1001)(1100)(1111)$$

$$= a'bc'd + ab'c'd' + ab'c'd + abc'd' + abcd$$

$$= a'bc'd + ab'c'(d'+d) + abc'd' + abcd$$

$$= a'bc'd + ab'c' + abc'd' + abcd$$

Implementing using only NAND Gates:

[Please Turn Over]

$F = a'bc'd + ab'c' + abc'd' + abcd$