LAB REPORT

CSE 1204

Digital Logic Design

Khulna University of Engineering and Technology

Computer Science and Engineering

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Section	: B
Semester	: 2nd Semester
Experiment No	: 02

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Experiment name: Realization of a Boolean Function.

AIM: To simplify the given expression and to realize it using basic gates and universal gates.

Components required:

IC 7400, IC 7408, IC 7406, IC 7402, Patch cords, IC Trainer Kit.

Theory:

Canonical forms: Any boolean function can be written in disjunctive or conjunctive normal form.

A boolean function can be represented by K-Maps in which each cell corresponds to a minterm. The cells are arranged in such a way that any two immediately adjacent cells in such a way that any two corresponds to tw minterm of distance.

For a function of two variables, say $f(x, y)$.

	x'	x
y'	$f(0,0)$	$f(1,0)$
y	$f(0,1)$	$f(1,1)$

For a function of three variables, $f(x, y, z)$

	$x'y'$	$x'y$	xy	xy'
z'	$f(0,0,0)$	$f(0,1,0)$	$f(1,1,0)$	$f(1,0,0)$
z	$f(0,0,1)$	$f(0,1,1)$	$f(1,1,1)$	$f(1,0,1)$

For a function of four variables, $f(w, x, y, z)$

	$w'x'$	$w'x$	wx	wx'
$y'z'$	$f(0,0,0,0)$	$f(0,0,0,1)$	$f(0,0,1,1)$	$f(0,0,1,0)$
$y'z$	$f(0,1,0,0)$	$f(0,1,0,1)$	$f(0,1,1,1)$	$f(0,1,1,0)$
yz	$f(1,1,0,0)$	$f(1,1,0,1)$	$f(1,1,1,1)$	$f(1,1,1,0)$
yz'	$f(1,0,0,0)$	$f(1,0,0,1)$	$f(1,0,1,1)$	$f(1,0,1,0)$

yz \ wx	00	01	11	10
00	0	4	12	8
01	1	5	13	9
11	3	7	15	11
10	2	6	14	10

Block diagrams of the ICs:

IC (7400) NAND Gate:

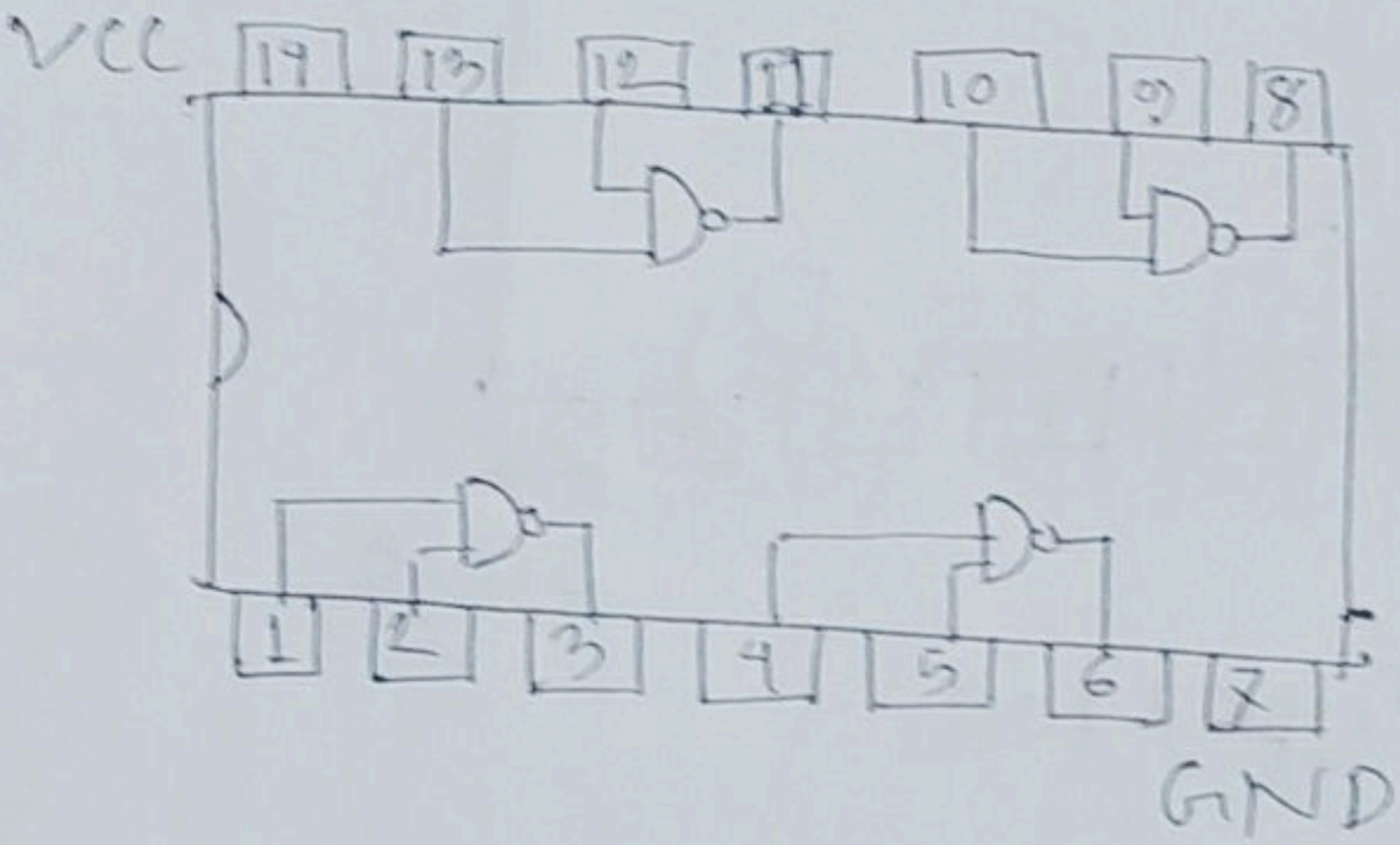


Fig: IC 7400

IC 7402 (NOR Gate)

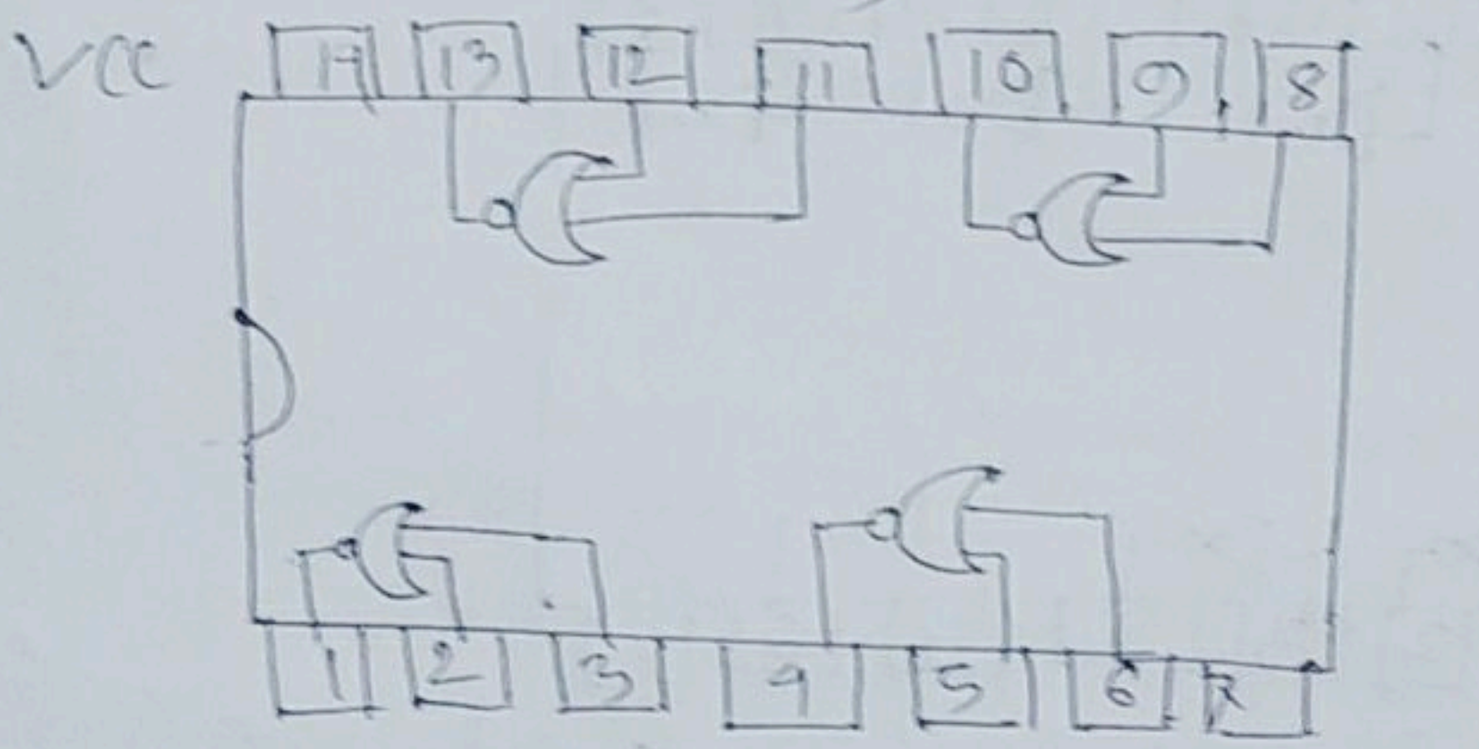


Fig: IC 7402

IC 7408 (AND Gate) :

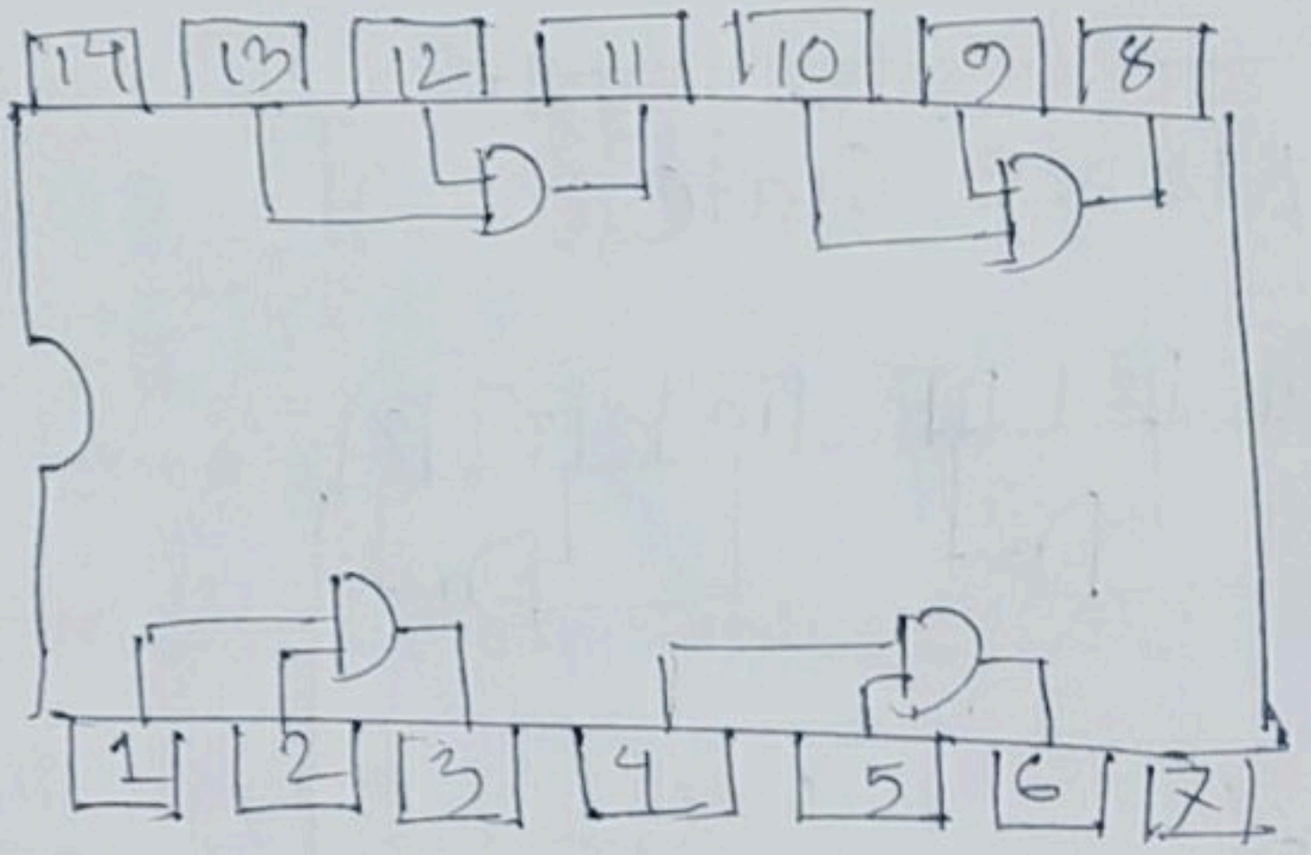


Fig: IC 7408

IC 7406 (NOT Gate)

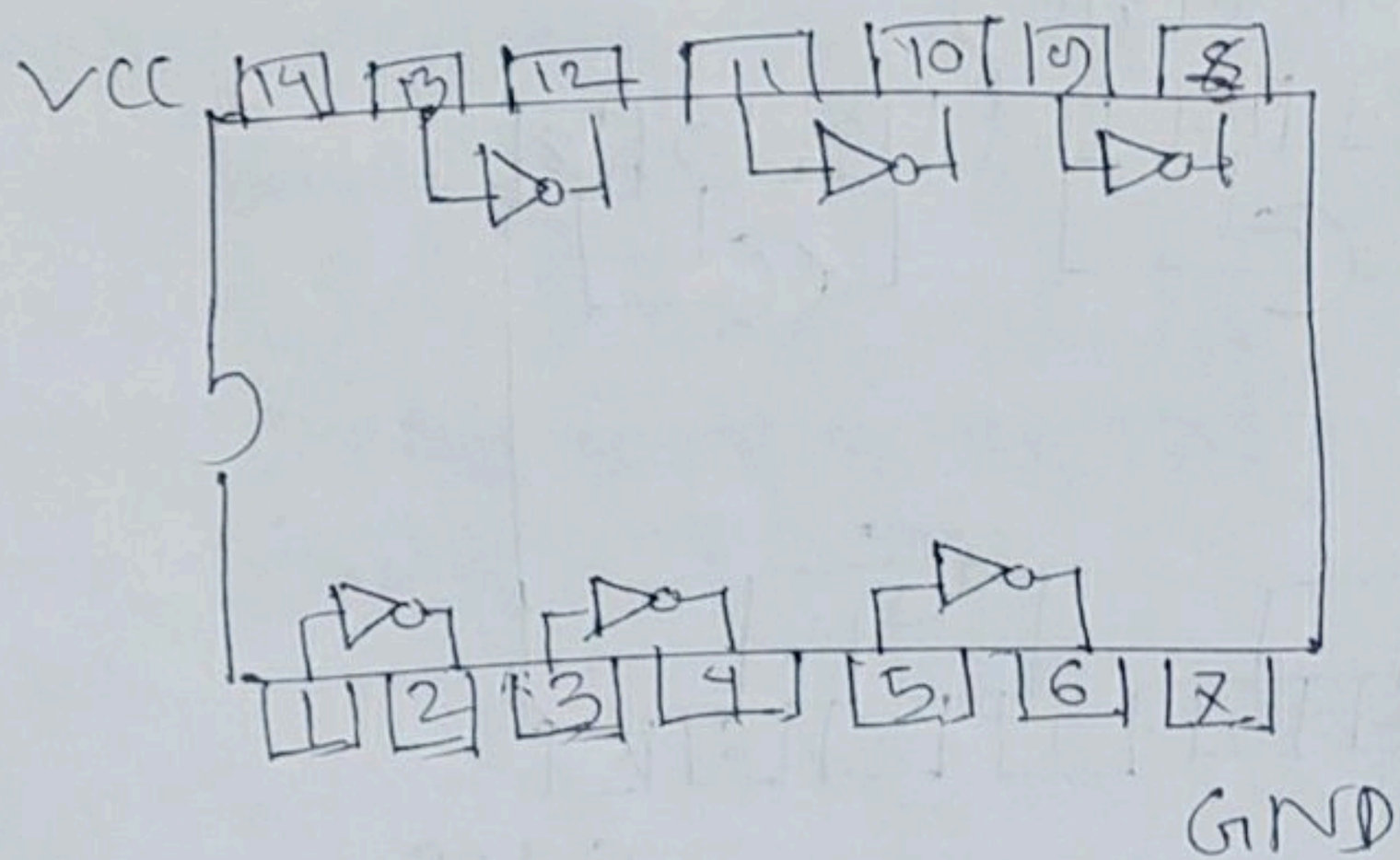


Fig: IC 7406

IC. (7432) OR Gate:

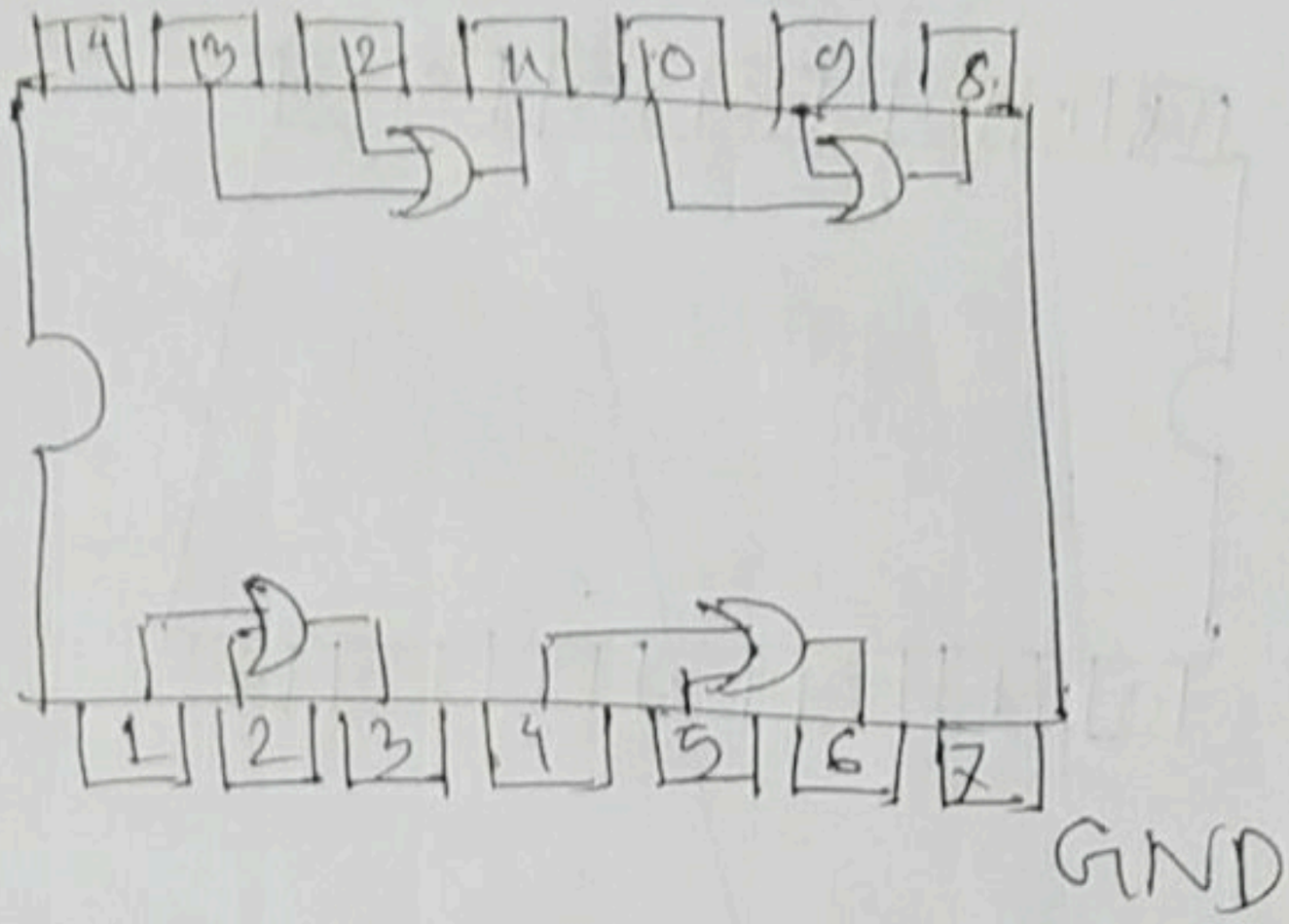


Fig: IC7432

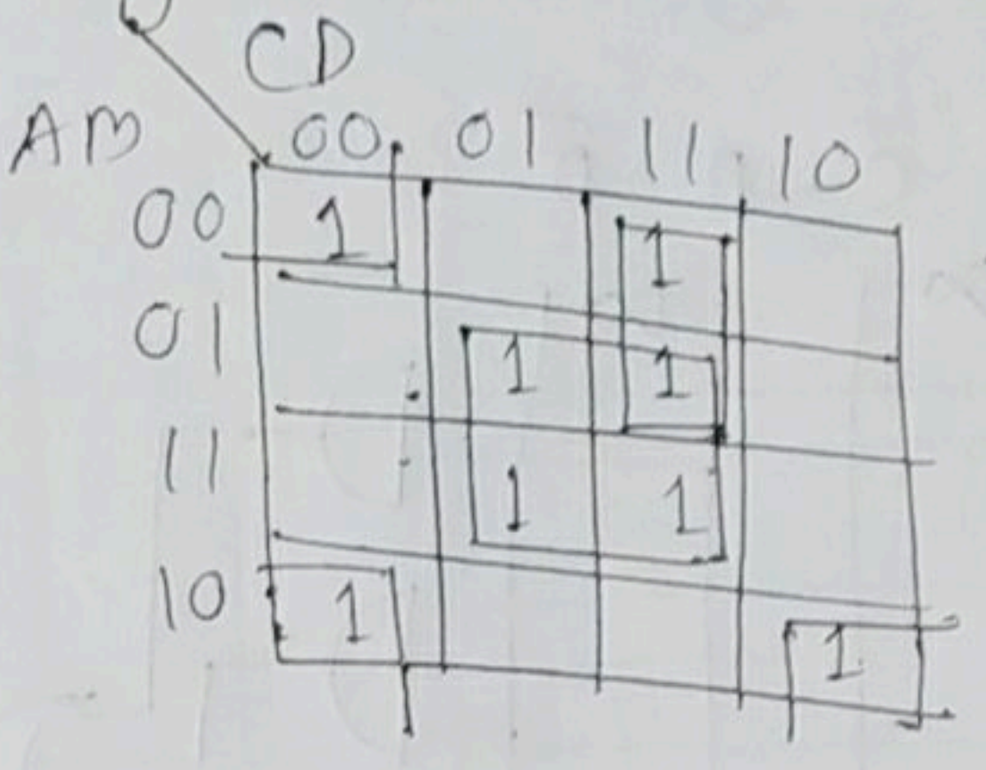
Realization of Boolean Expression:

Given, $F = A'B'C'D' + A'B'CD + A'BC'D + A'BCD + ABD + AB'C'D' + AB'CD'$

$= A'B'C'D' + A'B'CD + A'BC'D + A'BCD + ABD(C + \bar{C}) + AB'C'D' + AB'CD'$

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

Karnaugh Map:



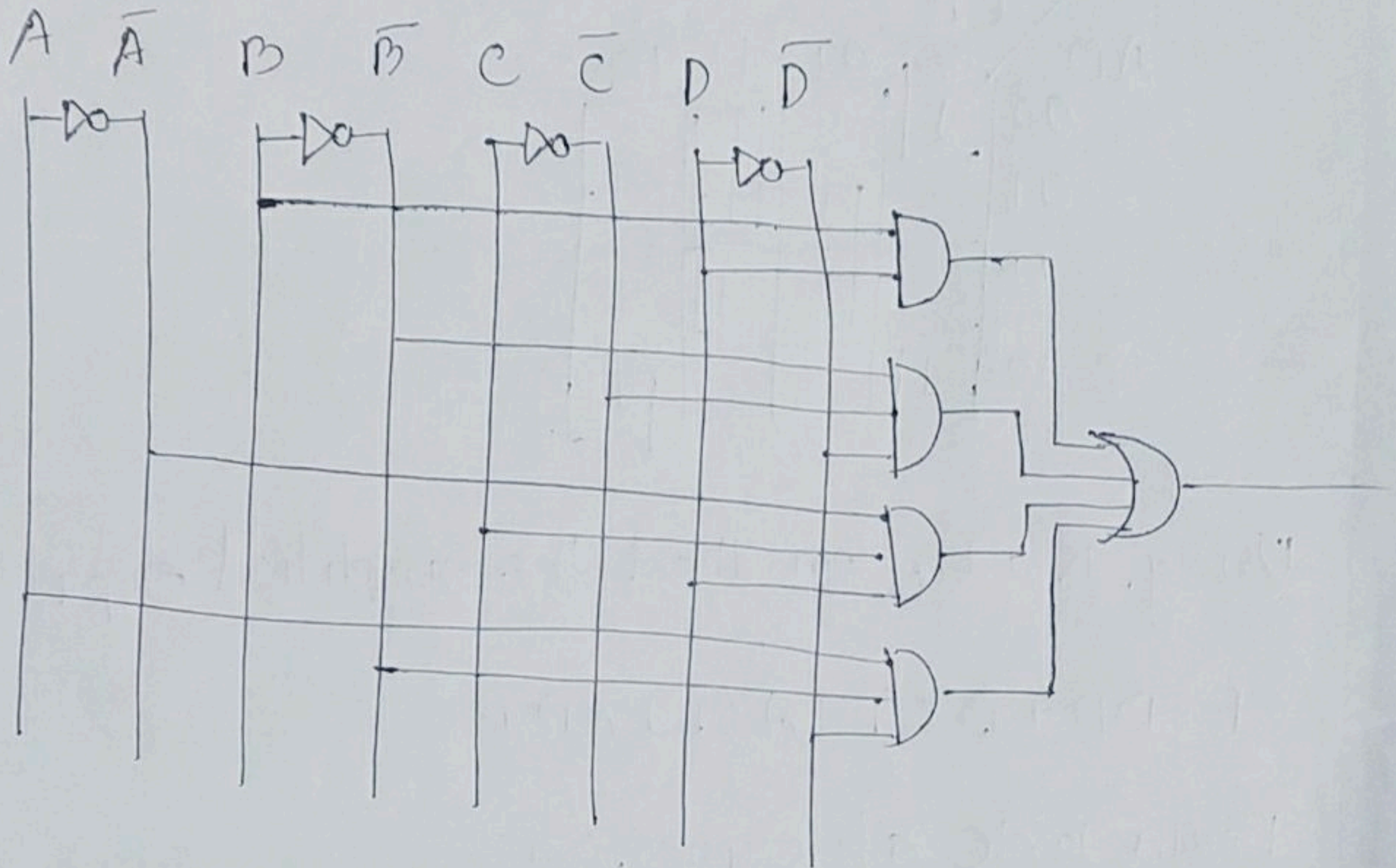
Using K-Map method, the simplified expression,

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

Truth Table of expression:

Input				Output	Input				Output
A	B	C	D	F	A	B	C	D	F
0	0	0	0	1	1	0	0	0	1
0	0	0	1	0	1	0	0	1	0
0	0	1	0	0	1	0	1	0	1
0	0	1	1	1	1	0	1	1	0
0	1	0	0	0	1	1	0	0	0
0	1	0	1	1	1	1	0	1	1
0	1	1	0	0	1	1	1	0	0
0	1	1	1	1	1	1	1	1	1

Realizing using basic gates:



IC 7406 used : 1

IC 7408 used : 1

IC 7432 used : 1.

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

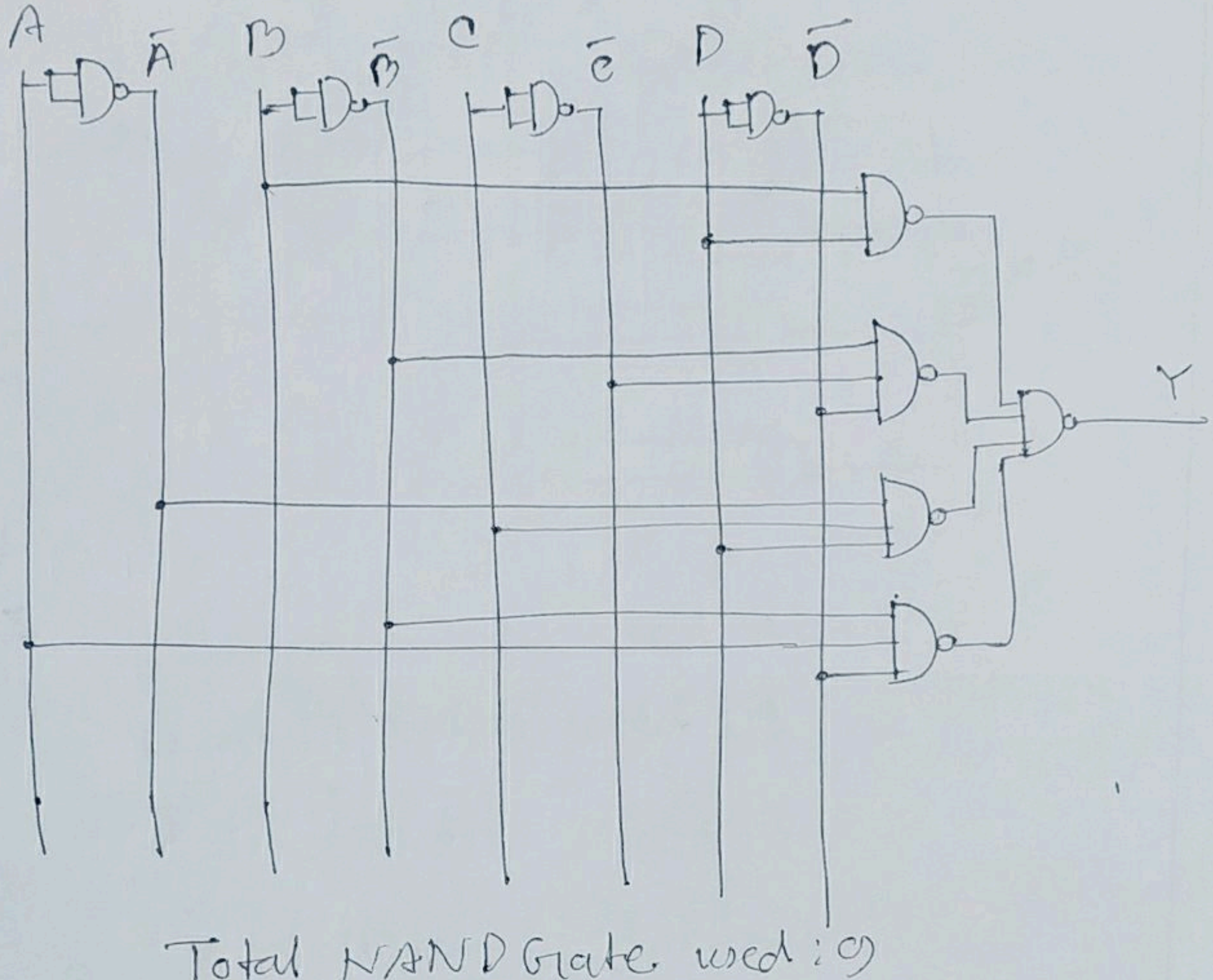
$= (BD + B'C'D' + A'CD + AB'D')''$

$= \{(BD)' \cdot (B'C'D')' \cdot (A'CD)' \cdot (AB'D')'\}'$

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

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

Realizing using NAND Gate:

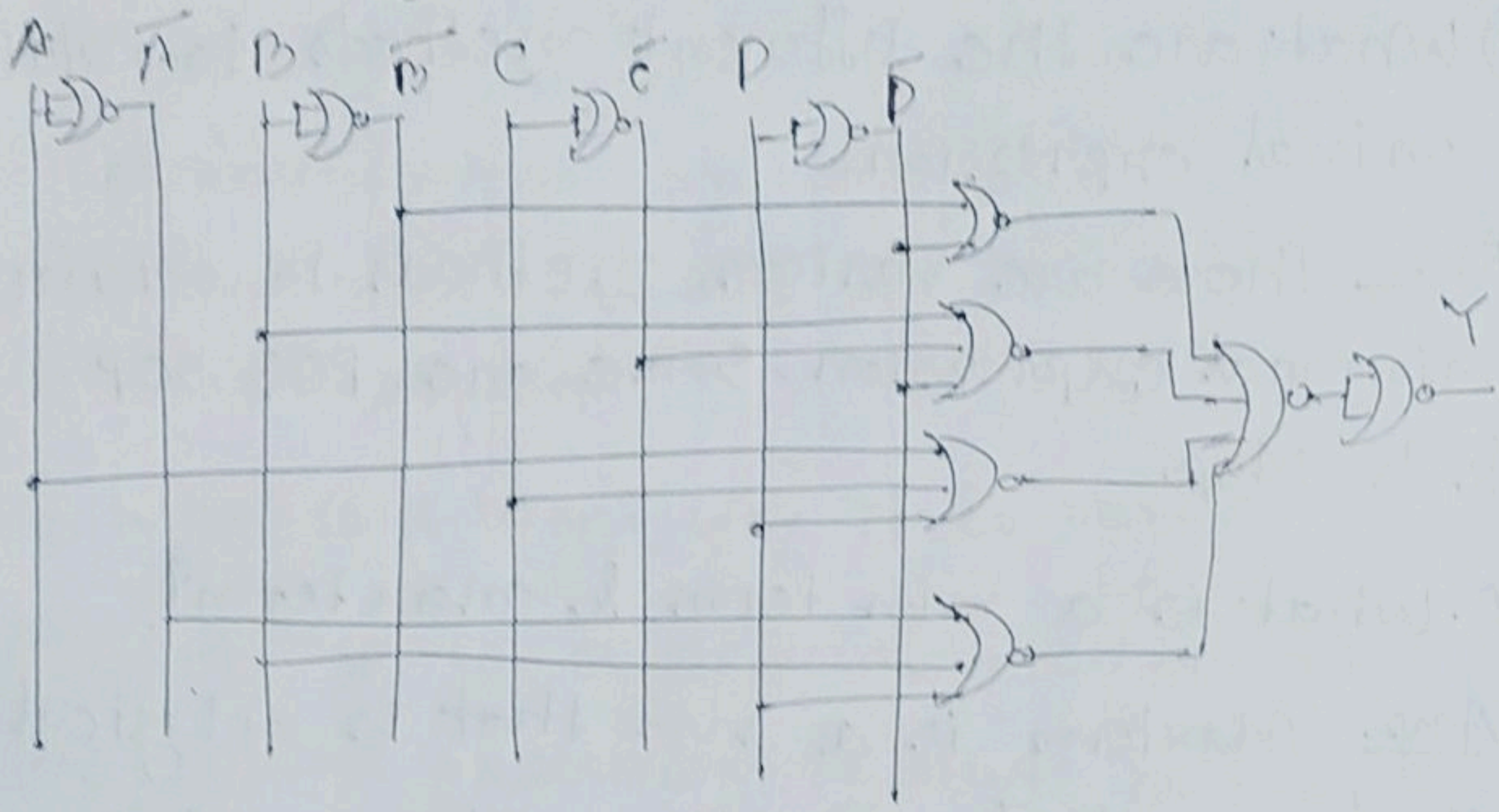


Total NAND Gate used : 9

Total IC chips used : 3

Here, $Y = \{(BD)' \cdot (B'C'D')' \cdot (A'CD) \cdot (AB'D')')'$

Realize using NOR Gate:



Total NOR Gate used : 10

Total IC Chips used : 3

Here, $Y = \{(B'+D') + (B+C+D)' + (A+C'+D')' + (A'+B+D)'\}'$

Viva question:

(1) What are the different methods to obtain minal expression.

Ans: There are various methods to obtain minimal expression, Some are. POS, SOP & K-Map.

2. What is a min term & max term?

Ans: 'Maxterm' is a sum that is a logical or of a set of variables while 'minterm' is a product term in which each variables appears once.

3. State the difference between SOP & POS.

Ans: SOP is method of describing a boolean expression using a set of minterms or product terms. POS is a method of describing a boolean expression using a set of max terms or sum terms.

4. What is meant by canonical representation?

Ans: It is one which provides the simplest representation of an boolean in a unique way and which allows it to be identified in a unique way.

5. What is K-Map? why it is used?

Ans: K-Map is a pictorial method used to minimized expressions without having to use boolean algebra theorems and equations. It is mostly used to simplify a boolean function.

6. What are the universal gates?

Ans: NAND and NOR Gates are the universal gates.