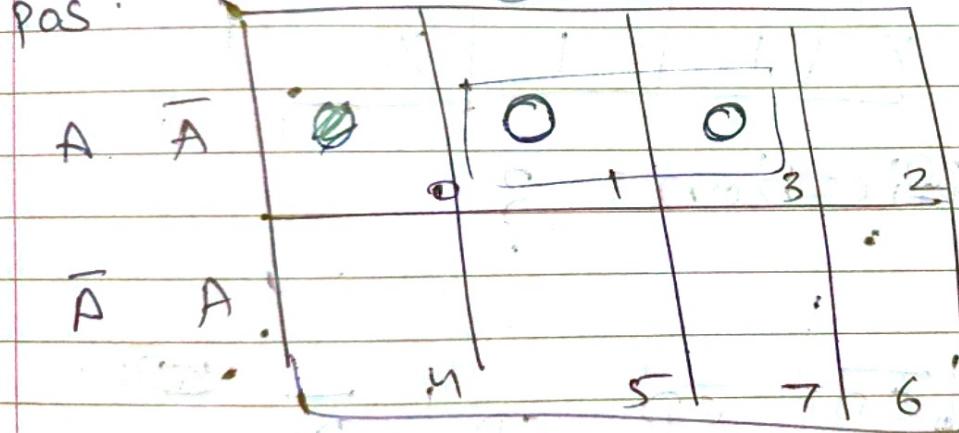


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① Simplify  $f(A, B, C) = (A + B + C') (A + B' + C')$

B+C B+C' B+C' B+C POS  
POS.  $\overline{BC}$   $\overline{BC}$  BC  $BC'$   $\rightarrow$  SOP



$$f_1' = (A + \bar{C}) \quad \checkmark$$

(2) write the minterms for.

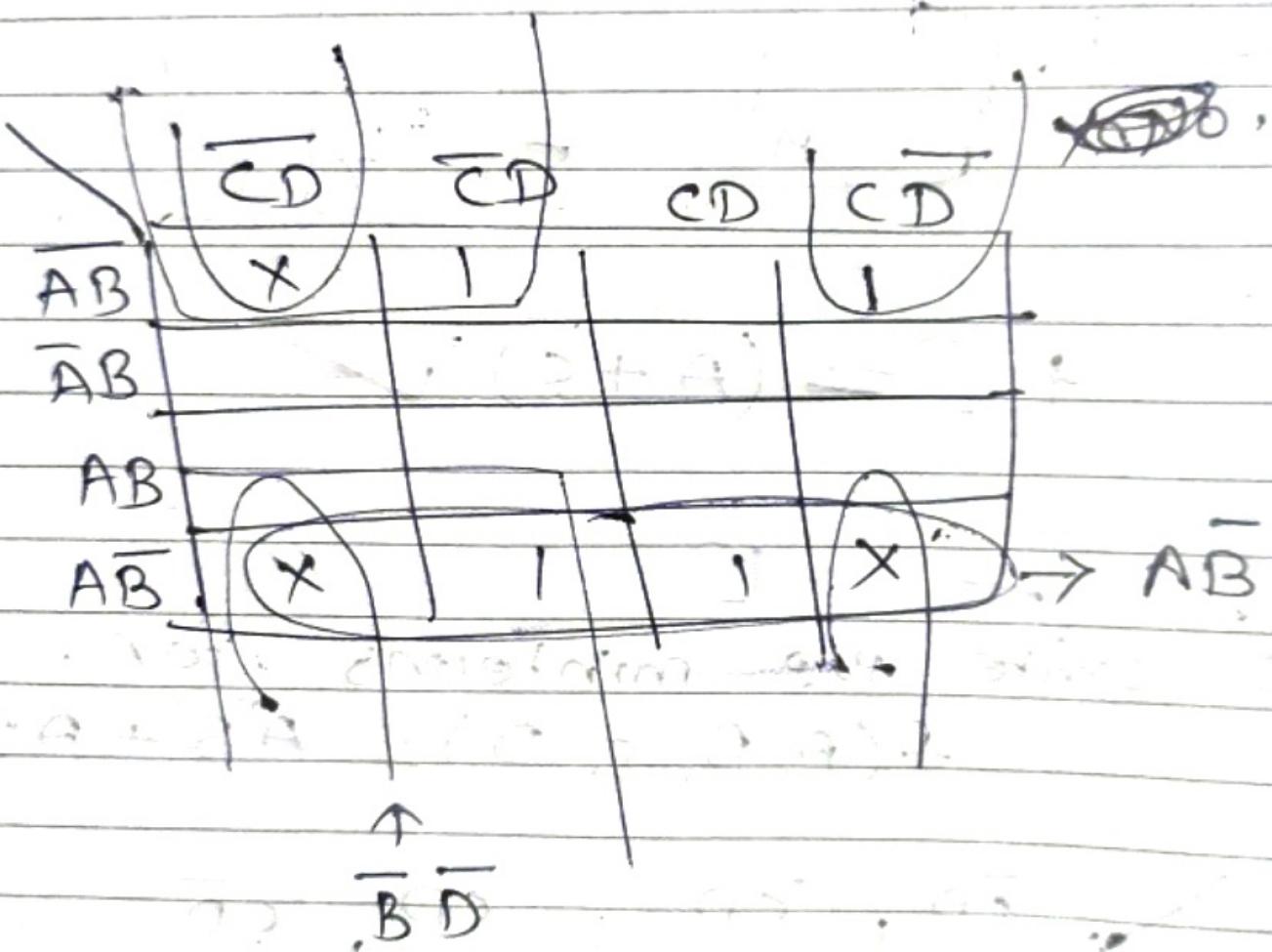
$$f(A, B, C, D) = A'B' + AB + BC'D'$$

$\bar{AB}$	$\bar{CD}$	$\bar{C}\bar{D}$	$CD$	$C\bar{D}$
$\bar{AB}$	1	0	1	1
$\bar{AB}$	4	5	7	26
$AB$	1	12	13	15
$AB$	8	9	11	10

$$\Rightarrow \Sigma (0, 1, 2, 3, 6, 12, 13, 14, 15)$$

	$\bar{C}D$	$\bar{C}D$	$CD$	$CD$
$AB$	X	1	1	1
$\bar{A}B$				
$A\bar{B}$				
$AB$	X	1	1	X

Simplification ?



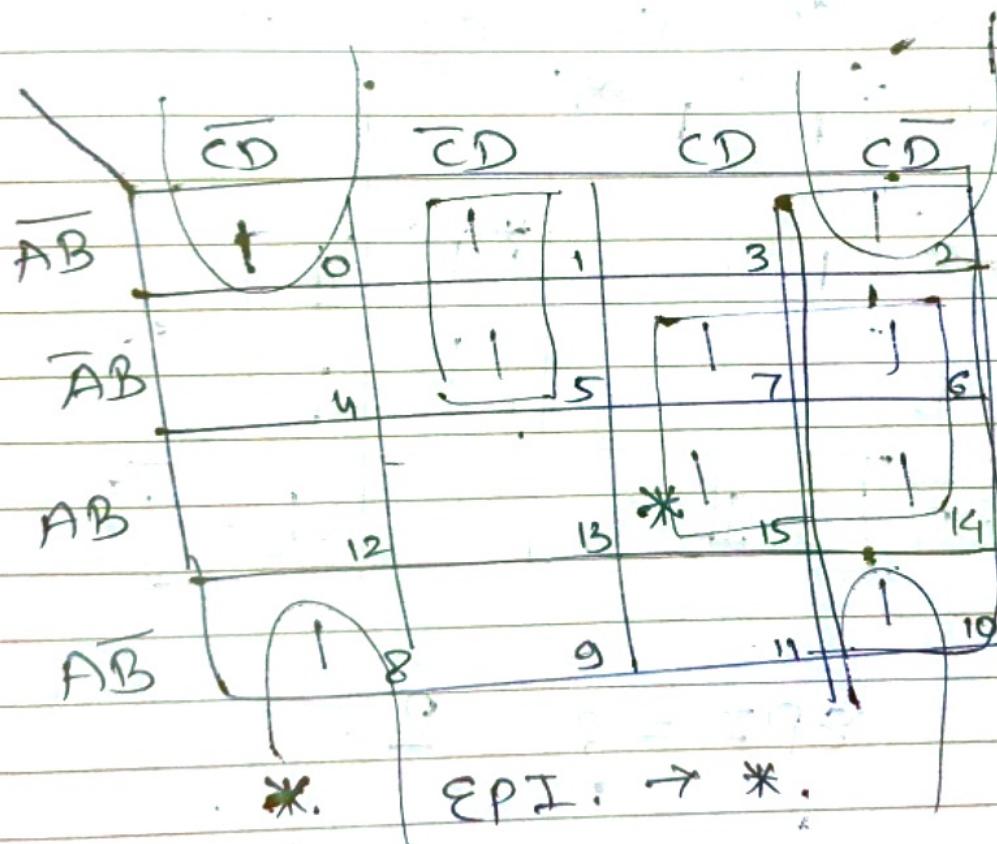
$$AB + \bar{B}D + \bar{B}C \quad \checkmark$$

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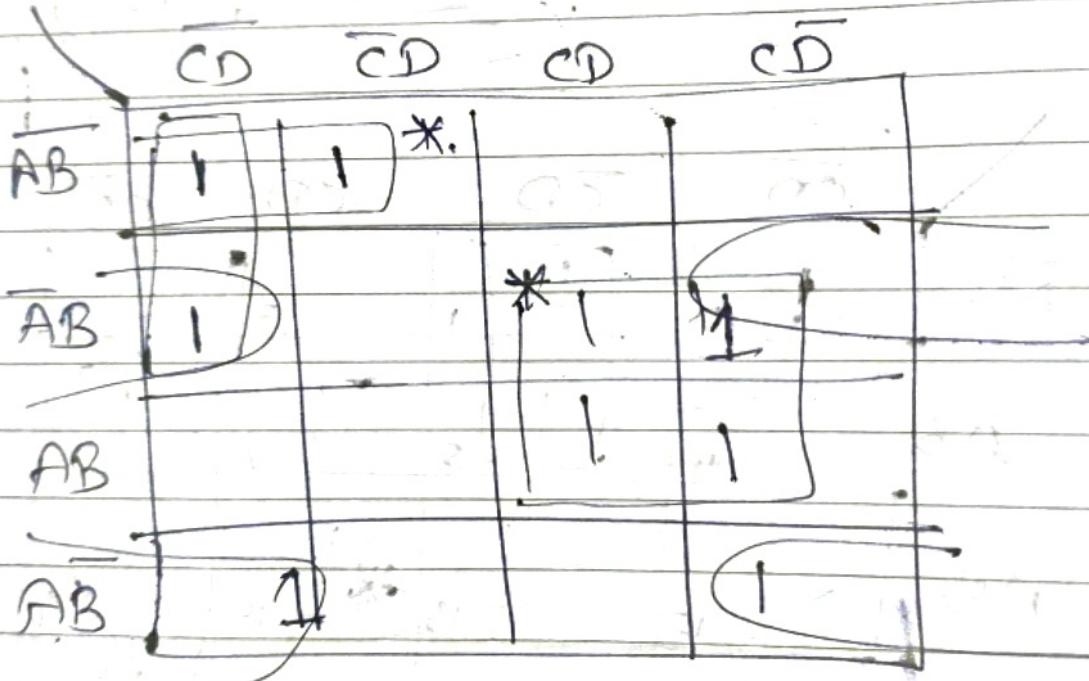
No. of Essential prime implicants ?

$$f(A, B, C, D) = \Sigma(0, 1, 2, 5, 6, 7, 8, 10, 14, 15)$$



$$f(A, B, C, D) = \pi(2, 3, 5, 9, 11, 12)$$

EPI?



EPI = ?

Conveet

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POS  $\rightarrow$  SOP

SOP  $\rightarrow$  POS

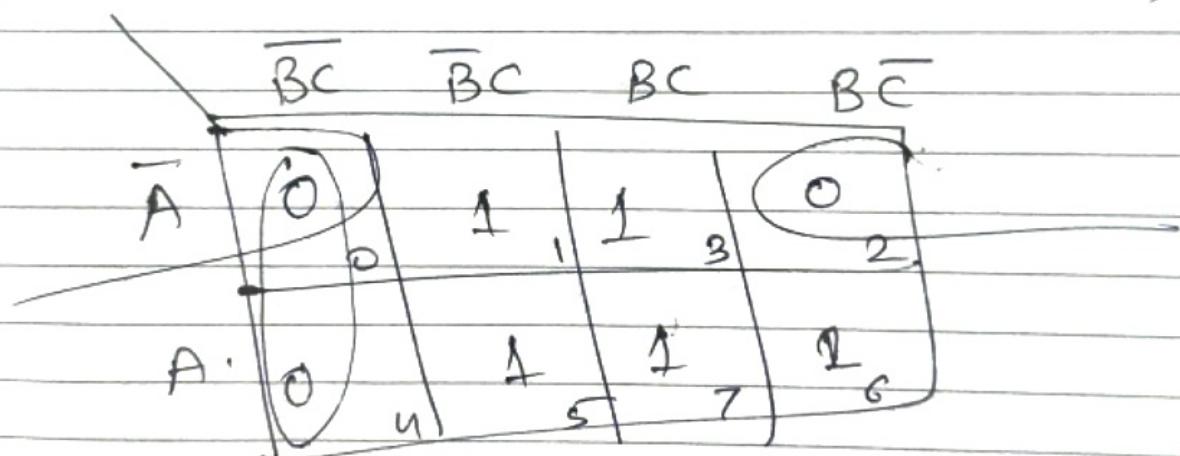
① Use Kmap.

② To convert POS into SOP:

If POS =  $\pi(0, 2, 4)$ .

Then SOP will be =  $(1, 3, 5, 6, 7)$

Ex. POS of  $(AB + C)$  will be 3.



If SOP =  $(AB + C) = \sum(1, 3, 5, 6, 7)$

Then POS =  $\pi(0, 2, 4)$  ✓

$$= \overline{B}C + \overline{A}\overline{C} \rightarrow \text{SOP.}$$

$$= (B+C)(A+C) \text{ POS.}$$

Q. Convert into POS form

$$f = x'y'z' + xy'z + xyz'$$

	$\bar{y}z$	$\bar{y}z$	$y\bar{z}$	$y\bar{z}$
$\bar{x}$	1	0	0	0
$x$	1	0	0	1

$$\text{POS} = z + \bar{x}y \checkmark$$

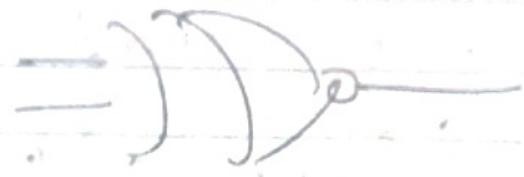
few points About Nand.

$$\equiv D_o - \overline{AB}$$

A	B	$\overline{AB}$ /output
0	0	1
0	1	1
1	0	1
1	1	0

- ① if A is High, output will be inverted value of B as  $\overline{B}$
- ② o/p is low only when Both Inputs are High.

C. Xnor gate



A    B    O/P

0    0    1

0    1    0

1    0    0

1    1    1

① if B is low, o/p is inverted value of A.

$$\text{as } O \odot A = \overline{A}$$

② O/P is 1 only when both input are same.

③  $A \odot B = AB + \overline{A} \overline{B}$

$$[ A \odot B = \overline{A} \oplus B ]$$

$$= \overline{\overline{A} B} + \overline{A} \overline{B}$$

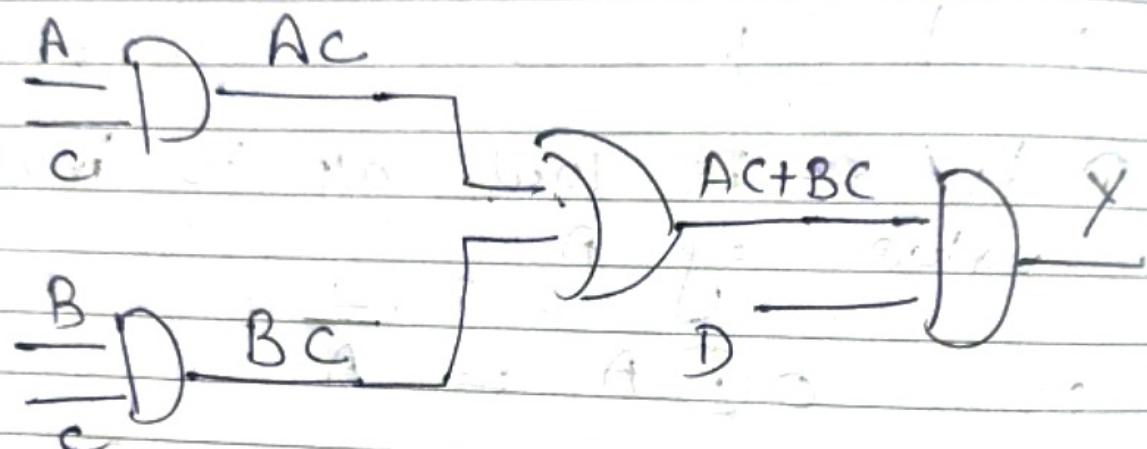
$$= AB + \overline{A} \overline{B}$$

$$[ A \odot B = A \oplus \overline{B} ]$$

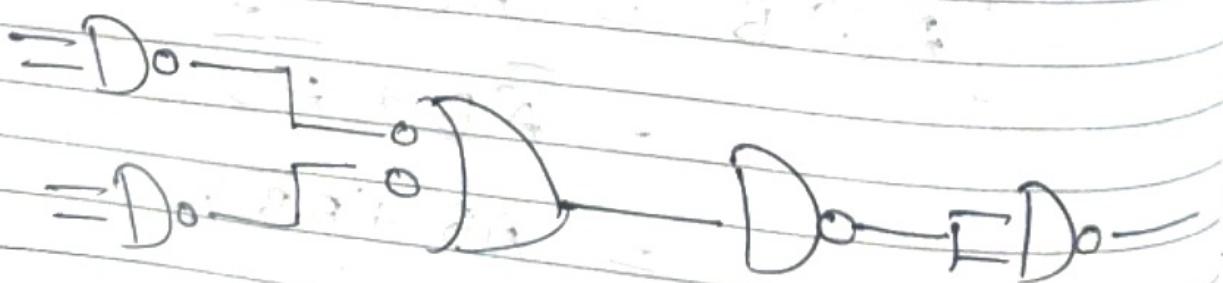
No. of Nand gates for -

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

$(AC+BC)D = Y$



Nand



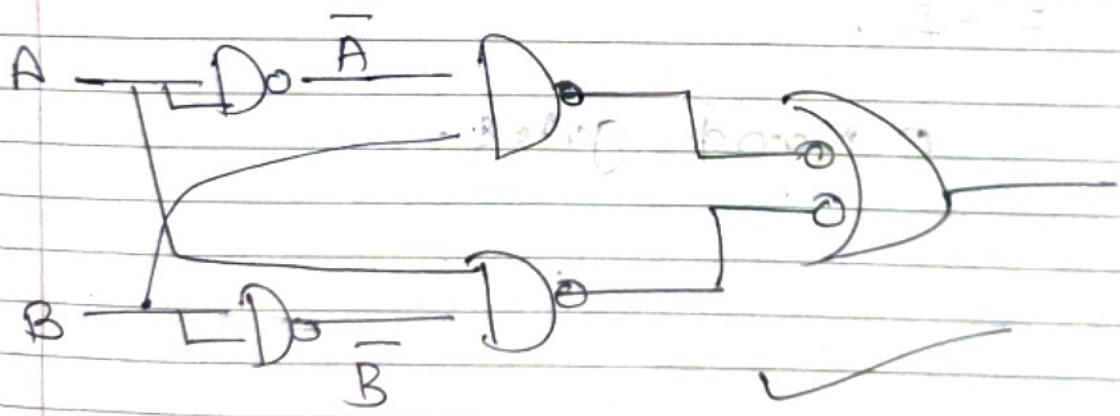
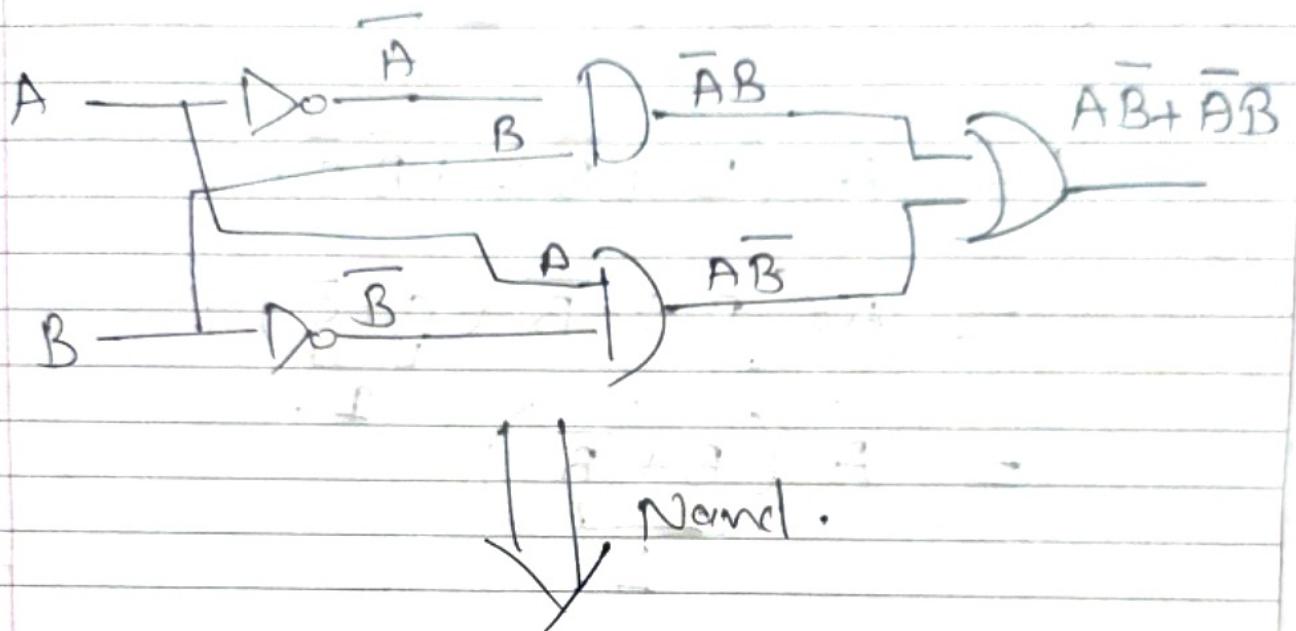
5 Nand

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X-OR gate using Nand Gate . . .

$$\bar{A}\bar{B} + \bar{B}\bar{A}$$



Min. Nand gates to realize  $\overline{AB} + \overline{AB'}\overline{C} + \overline{AB'}\overline{C'}$

$$\overline{AB} + \overline{AB'}\overline{C} + \overline{AB'}\overline{C'}$$

① Try to minimize first

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

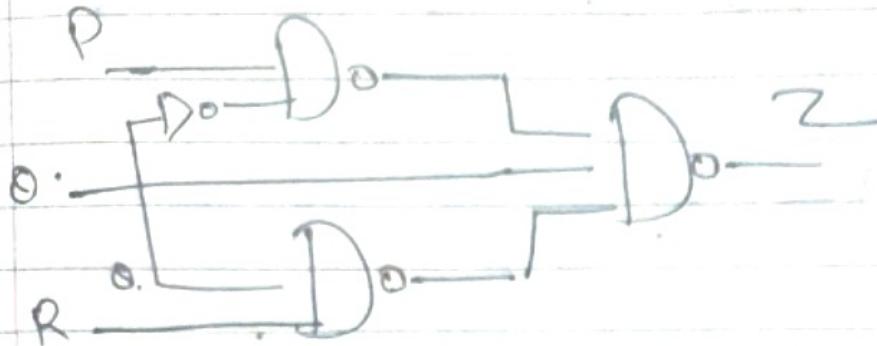
$$= A (\overline{B} + \overline{\overline{B}} (\overline{C} + \overline{\overline{C}}))$$

$$= A (\overline{B} + \overline{\overline{B}}) \quad 1.$$

$$= A.$$

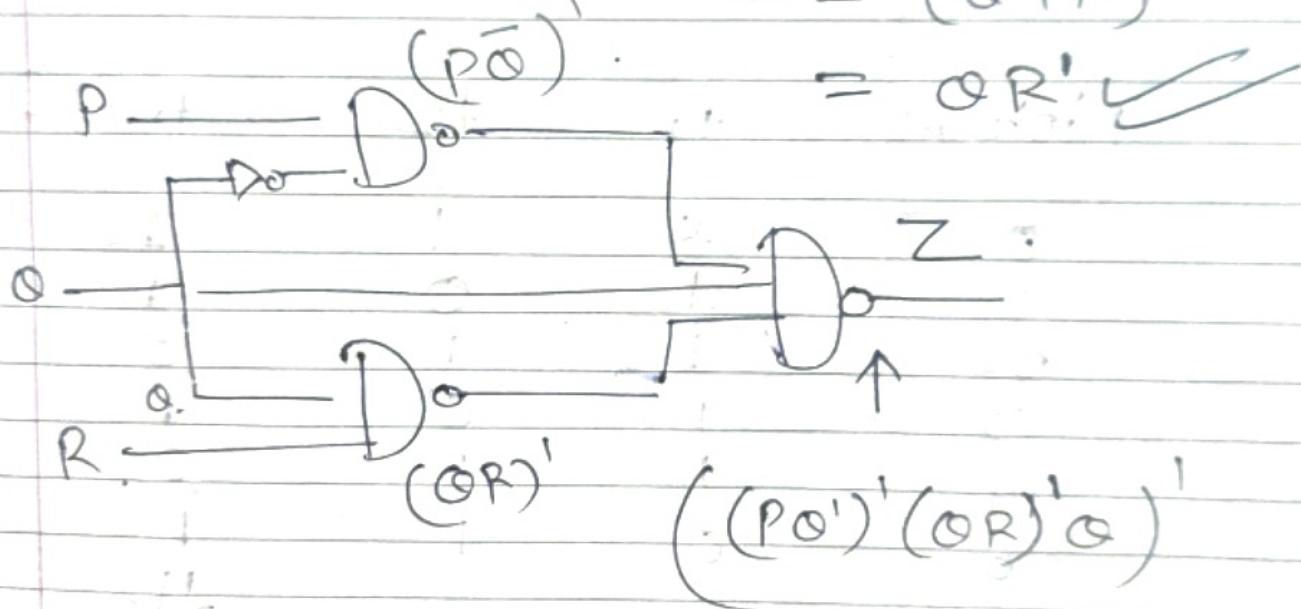
○ Nand gates.

Q. from the o/p  $Z$ , find  $\bar{Z}$ .



$$\text{Ans. } \bar{Z} = \bar{O}R, \quad Z = (\bar{O} + R)$$

$$Z' = (\bar{O} + R)'$$



$$= (PO')' + (OR)' + O'$$

$$= (PO' + OR + O')$$

$$= (PO' + O' + OR) = (P+1)\bar{O} + OR$$

$$= \bar{O} + OR = (\bar{O} + O)(\bar{O} + R) = \bar{O} + R$$

$$f_1(a, b, c) = \Sigma(1, 2, 3, 4)$$

$$f_2(a, b, c) = \Sigma(0, 2, 4, 9)$$

$$f_1 \oplus f_2 ?$$

$f_1 \oplus f_2$  says

if  $f_1$  is true then  $f_2$  must be false

if  $f_2$  is true then  $f_1$  false.

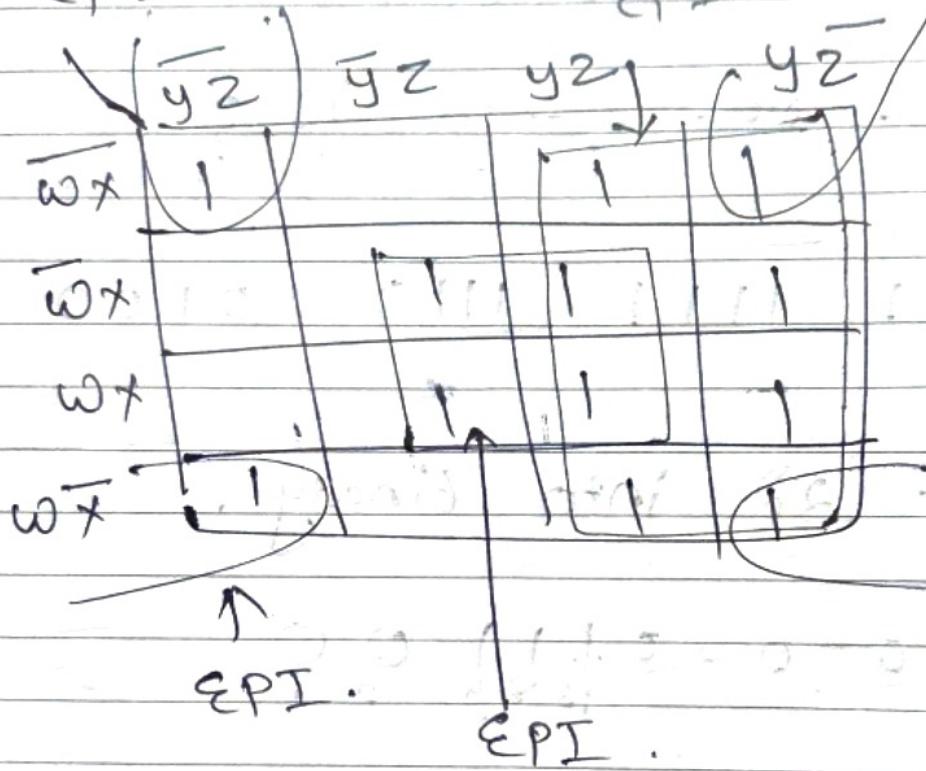
Minterm  $f_1$   $f_2$   $f_1 \oplus f_2$

0	0	1	1
1	1	0	1
2	1	1	1
3	1	0	0
4	1	1	1
6	0	1	1

$$f_1 \oplus f_2 = \Sigma(0, 1, 3, 6)$$

Q. EPI ?

EPI :



$$\text{EPI} = \gamma, xz, xz$$

(3)

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Q. In 16 bit 2's complement,

Decimal no. -28 is ?

Ans: 1111 1111 1110 0100

① Convert -28 into binary ..

0000 0000 000.11100  
 16 8 4 2 1

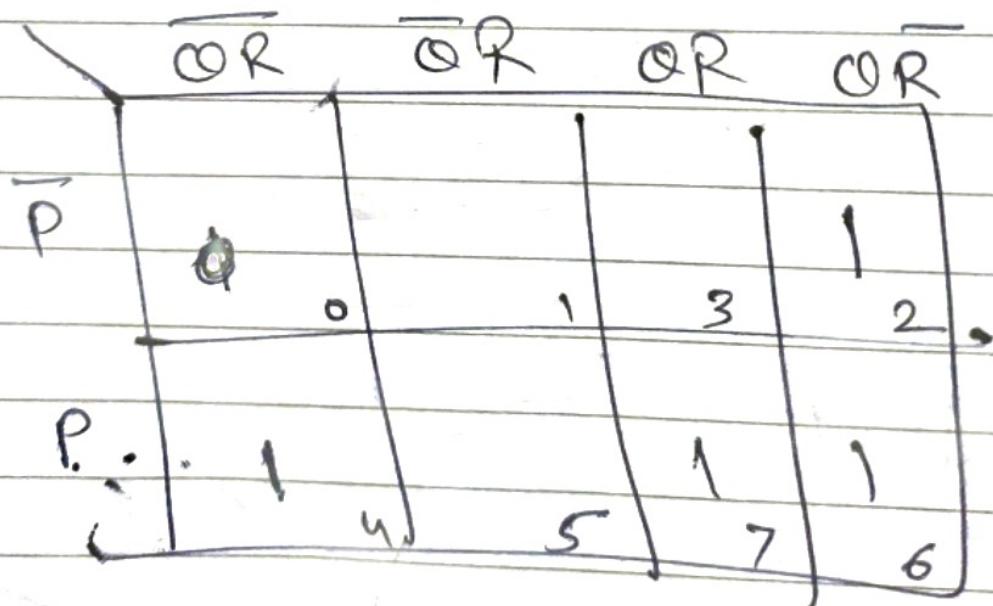
② Take 2's Complement —

1111 1111 1110 0100 ✓

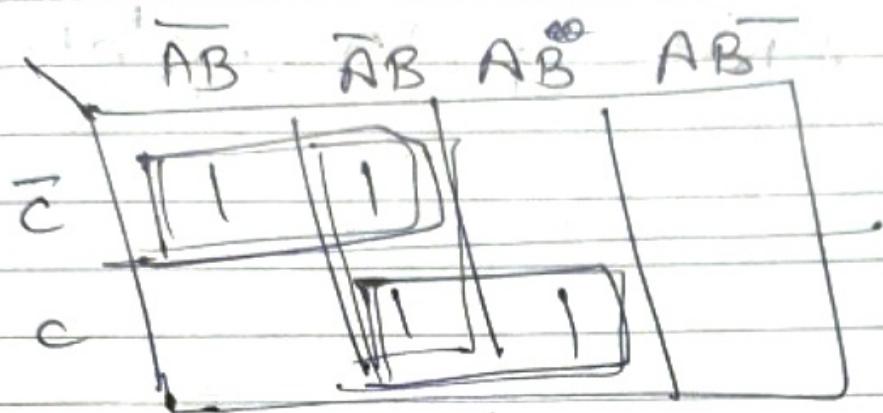
Minterm Exp. of

$$f(P, Q, R) = P Q + Q R' + P' R'$$

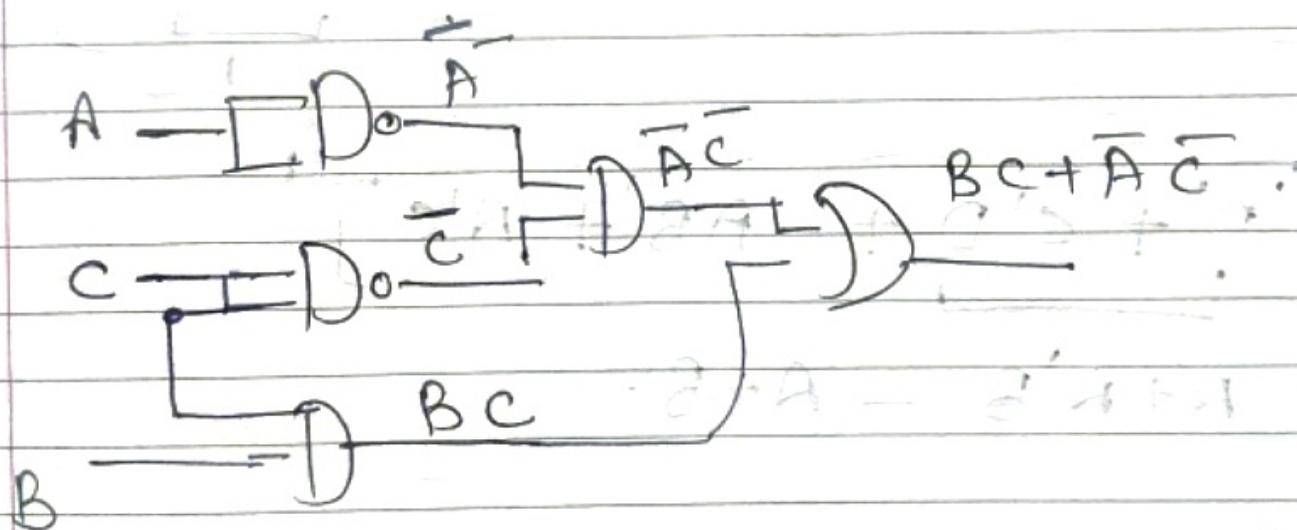
Ans:  $m_2$   $m_4$   $m_6$   $m_7$  ✓



which circuit is realization of  $f$  :-



$$f = \overline{C}\overline{A} + \overline{AB} + CB$$



Q. No. of minterms after minimizing

$$\overline{[D' + AB' + A'C + AC'D + A'C'D]}$$

Ans. 1.

① Take  $c'D$  common

$$\overline{[D' + AB' + A'C + c'D(A+A')]}'$$

$$\textcircled{2} \quad \overline{[D' + c'D + AB' + A'C]}'$$

$$A + A'B = A + B$$

$$\Rightarrow \overline{[D' + c' + AB' + A'C]}'$$

$$\Rightarrow \overline{(D' + AB' + A'C + c')}'$$

$$c' + A'$$

$$\overline{[D' + AB' + A' + c']}'$$

$$\overline{[D' + A' + B' + c']}' = ABCD \checkmark$$

$$A + A' = 1$$

$$A + A'B = A + B$$

$$A + AB = A$$

Q. Correct options.

$$P \oplus Q = P \odot Q. \quad \checkmark$$

$$\bar{P} \oplus Q = P \odot Q$$

$$\bar{P} \oplus \bar{Q} = P \oplus Q.$$

$$P \oplus \bar{P} \oplus Q = (P \odot \bar{P}) \oplus Q$$

$$P \oplus Q = (\bar{P} \bar{Q} + \bar{P} Q)$$

$$= (P \bar{Q})' (\bar{P} Q)'$$

$$= (P' + Q) (P + Q')$$

$$= \underbrace{P P'}_{\textcircled{O}} + P' Q' + P Q + \underbrace{Q Q'}_{\textcircled{O}}$$

$$= P Q + \bar{P} \bar{Q} = P \odot Q \quad \checkmark$$

$$\textcircled{2} \quad \bar{P} \oplus \bar{o} = P \oplus o$$

$$\Rightarrow (\bar{P}\bar{o}) + (\bar{P}\bar{o}) = (P\bar{o} + \bar{P}o)$$

$$= P \oplus o.$$

$$\textcircled{4} \quad \underbrace{P \oplus \bar{P}}_{1} \oplus o = \underbrace{P \oplus \bar{P}}_{0} \cdot \underbrace{\bar{o}}_{0}$$

$$[\bar{P}\bar{P} + P\bar{P}] = 1$$

$$\begin{array}{r} 00 \\ 01 - 0 \\ 10 - 0 \\ \hline 11 \end{array}$$

$$\Rightarrow 1 \oplus o \neq 0 \oplus o$$

$$\begin{array}{c} P \oplus o \\ \text{O/P: } 0 \oplus 1 \\ \hline 1 \end{array} \quad \begin{array}{c} P \oplus o \\ \text{O/P: } 0 \oplus 0 \\ \hline 0 \end{array}$$

As o's value is 0, 1.]