CS & IT ENGINEERING

Subject- Digital LOGIC

Chapter- LOGIC GATE

Lecture No. 3

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TOPICS TO BE COVERED

01 AND, OR GATE

02 NAND GATE

03 NOR GATE

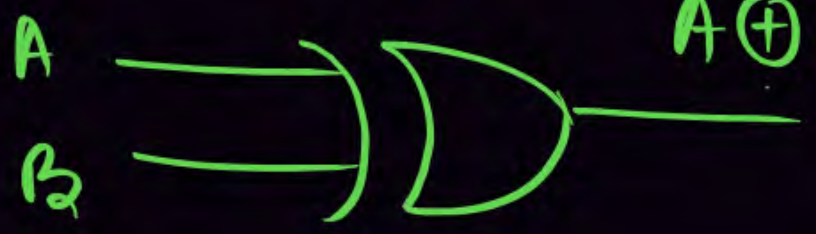
04 Discussion

Minimum no. of NAND NOR GATE

NAND / NOR

→ Universal Logic

X-OR GATE



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

X-NOR GATE

$$\overline{A \oplus B} = A \odot B = \bar{A}\bar{B} + AB$$

NOT GATE

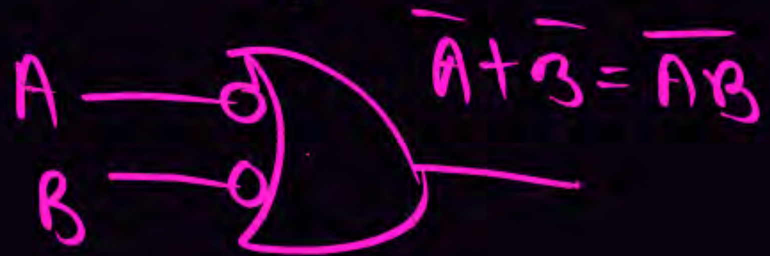
$$f = \frac{1}{2N \times \tau_{pd}}$$

AND

OR

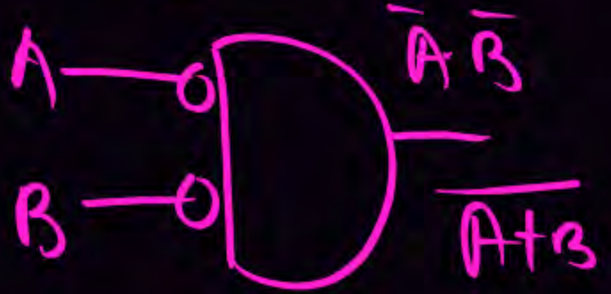
NAND

$\Updownarrow$



NOR

$\Updownarrow$



TTL floating terminal = 1

ECL floating terminal = 0

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

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

Distribution Theorem

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

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

Question: →

① $A + \bar{A}\bar{B} \Rightarrow (A+\bar{A})(A+\bar{B})$

$\Rightarrow 1 \cdot (A+\bar{B})$

$\Rightarrow A+\bar{B}$

② $\bar{A} + AB$

$(\bar{A}+A)(\bar{A}+B) = 1 \cdot (\bar{A}+B)$

$= \bar{A}+B$

$$A + \bar{A} = 1$$

$$A \cdot \bar{A} = 0$$

$$A \cdot A = A$$

$$A + A = A$$

$$\bar{A} + 0 = \bar{A}$$

$$A + 0 = A$$

$$\bar{A} + AB = (\bar{A} + A)(\bar{A} + B)$$

$$= 1 \cdot (\bar{A} + B) \Rightarrow \bar{A} + B$$

$$\bar{B} + AB = (\bar{B} + A) \cdot (\bar{B} + B)$$

$$= (A + \bar{B}) \cdot 1$$

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

$$\overline{(\bar{A}+B)(A+\bar{B})}$$

$$\overline{(\bar{A}+B)}+\overline{(A+\bar{B})}$$

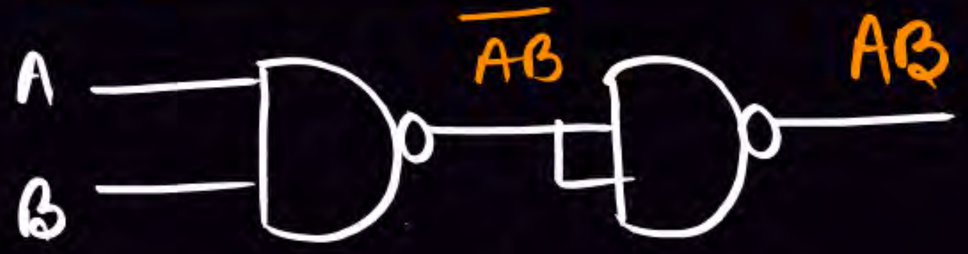
$$\bar{\bar{A}}\,\bar{B}+\bar{A}\,\bar{\bar{B}}$$

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

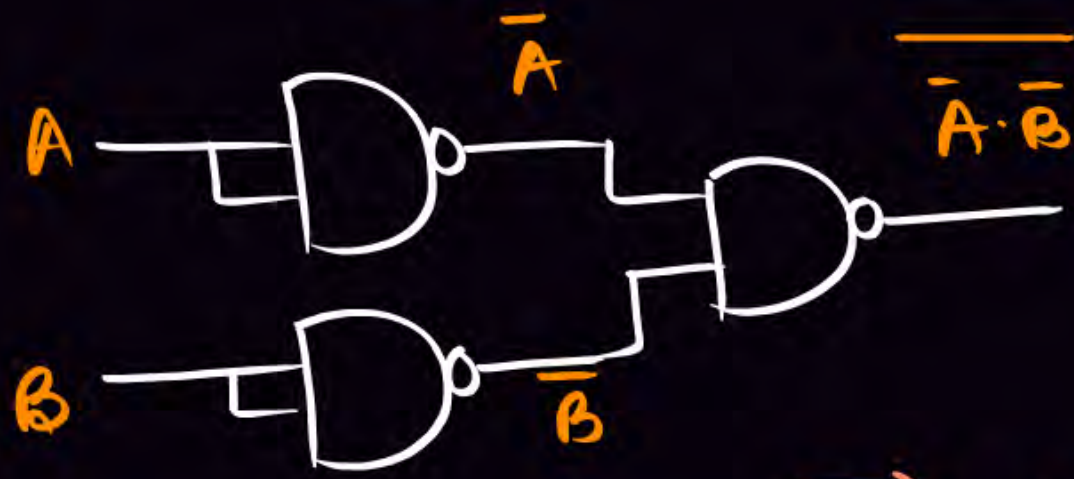
NAND AS A UNIVERSAL LOGIC :→

① NOT GATE :→

② AND GATE :→

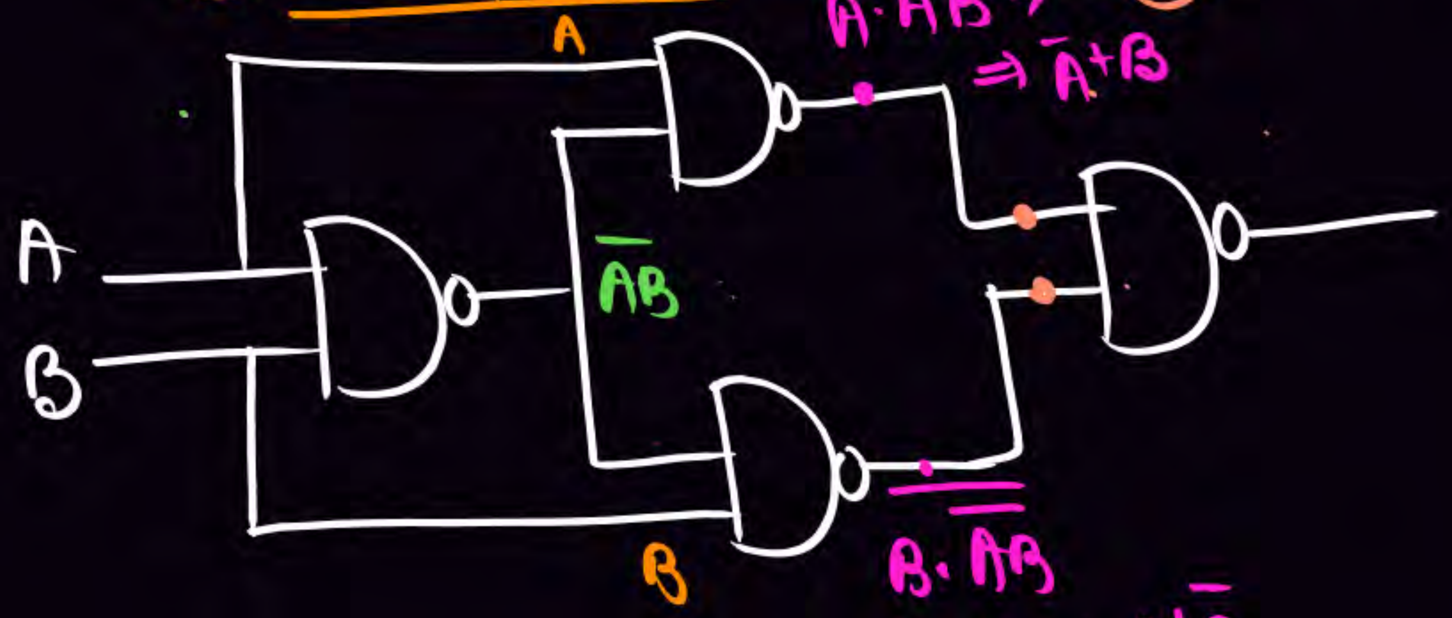


③ OR GATE :→



$$\overline{\bar{A}\cdot\bar{B}} \Rightarrow \bar{\bar{A}} + \bar{\bar{B}}$$
$$\Rightarrow A+B$$

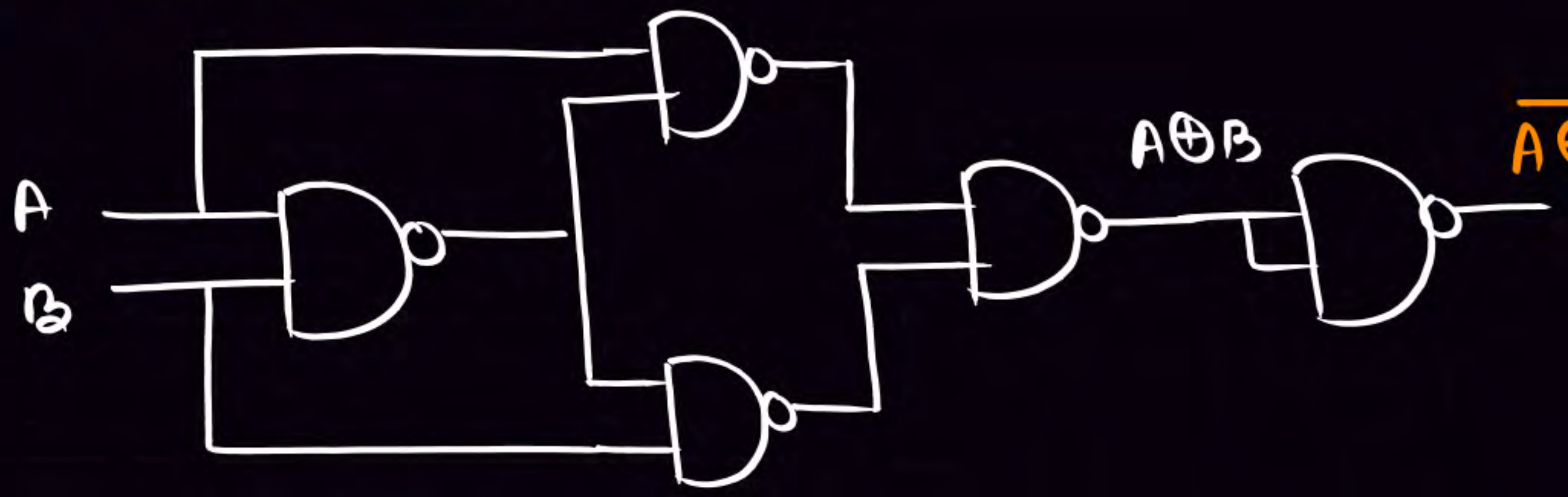
④ X-OR GATE :→



$$\overline{A\cdot\overline{AB}} \Rightarrow \bar{A}+AB = (\bar{A}+A)(\bar{A}+B)$$
$$\Rightarrow \bar{A}+B$$

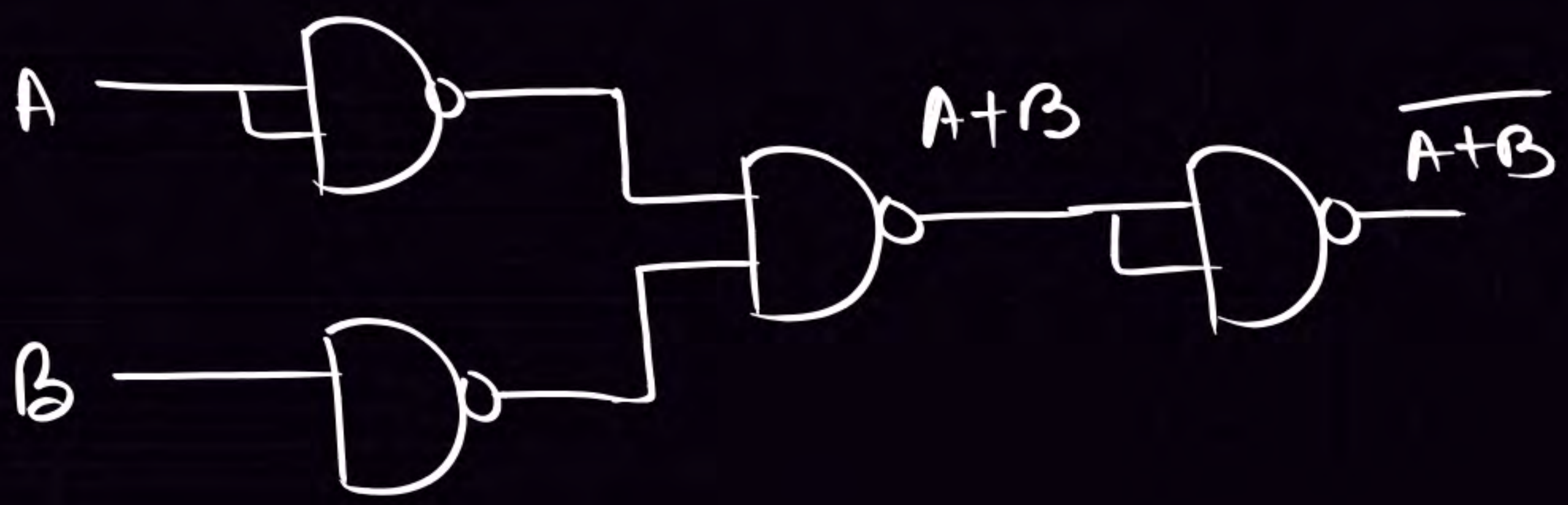
$$\overline{B\cdot\overline{AB}}$$
$$\Rightarrow \bar{B}+AB \Rightarrow A+\bar{B}$$

⑤ X-NOR GATE



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

(6) NOR GATE



	NAND	NOR
NOT	1	1
AND	2	3
OR	3	2
X-OR	4	5
X-NOR	5	4
NAND	1	4
NOR	4	1

Q.1

MCQ

Which of the following option is called universal logic?

A NAND

B NOR

C Both A & B

D None

Q.2

MCQ

Which of the following option is called universal logic?

(A) NAND

(B) NOR

(C) AND

(D) OR

Q.3

MSQ

Which of the following option(s) is/are called universal logic?

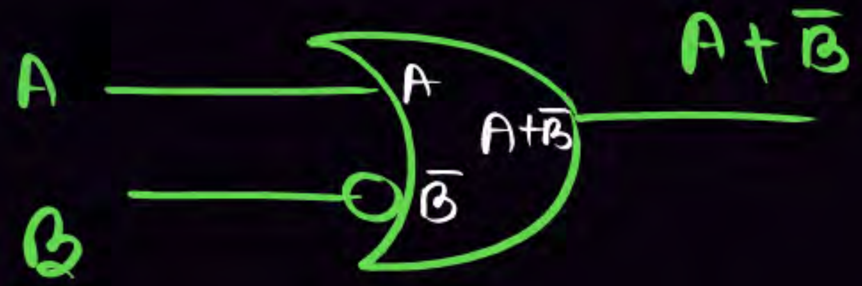
(A) $\left(\overline{A+B}\right) \longrightarrow$ NOR

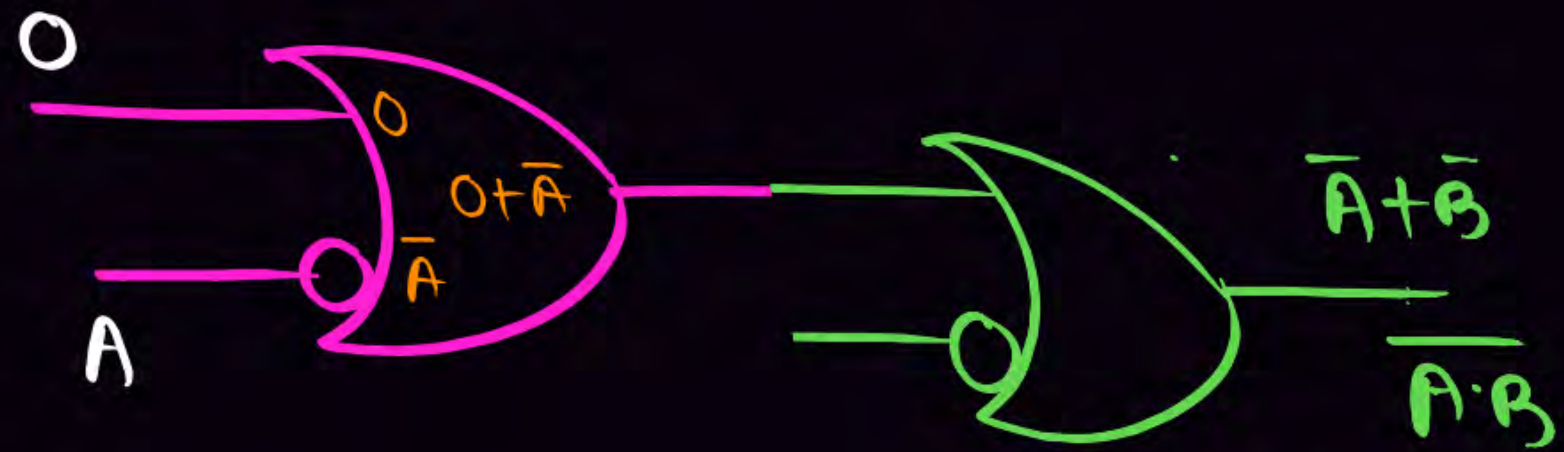
(B) $\left(\overline{A \cdot B}\right) \longrightarrow$ NAND

(C) $\left(A+\overline{B}\right)$

(D) $A \cdot \overline{B}$

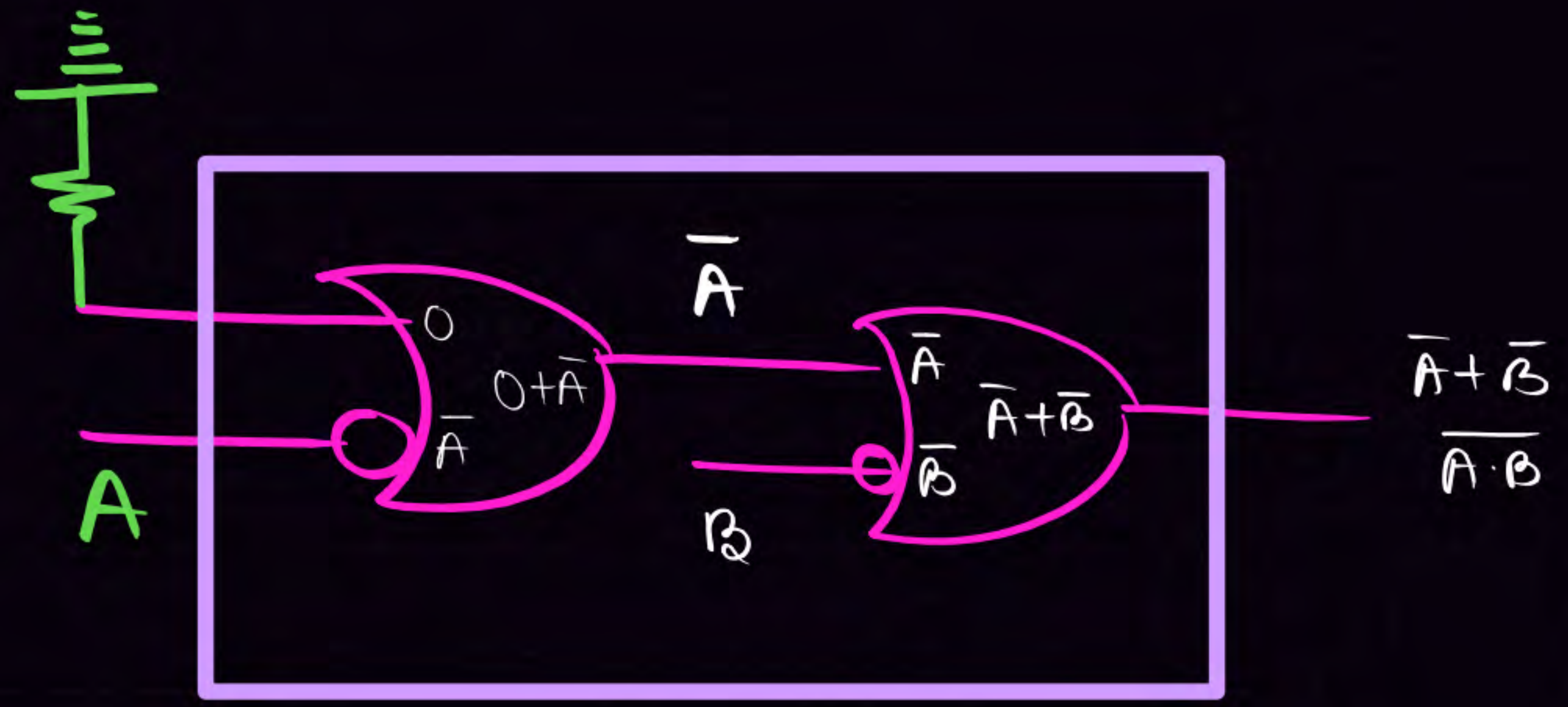
$A+\overline{B}$





$\overline{A\cdot B}$

$\overline{A+B}$

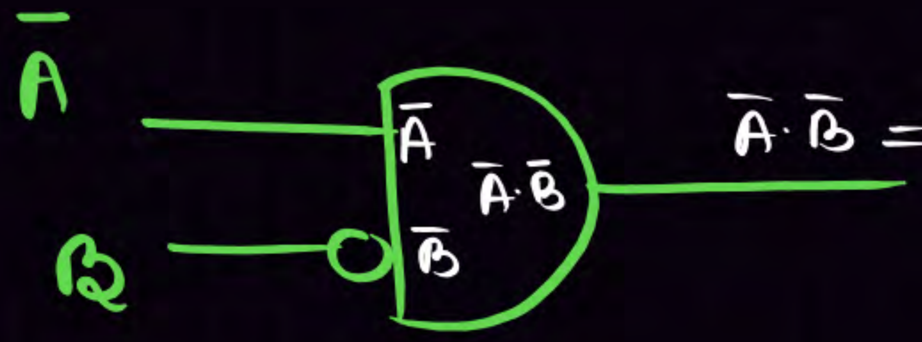


A
0
$\bar{A}$
$0+\bar{A}$
$\bar{A}$
$\bar{A}$
$\bar{B}$
$\bar{A}+\bar{B}$
B
$\bar{A}+\bar{B}$
$\overline{A \cdot B}$

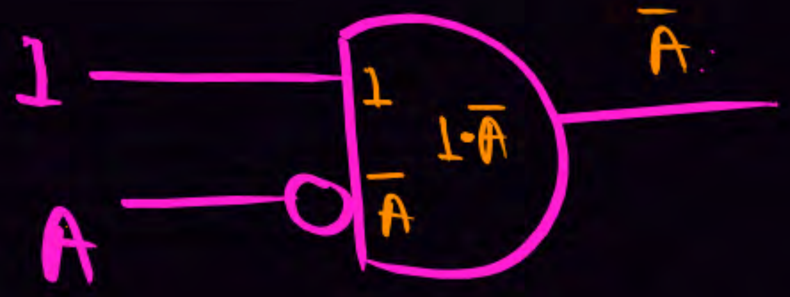
NAND

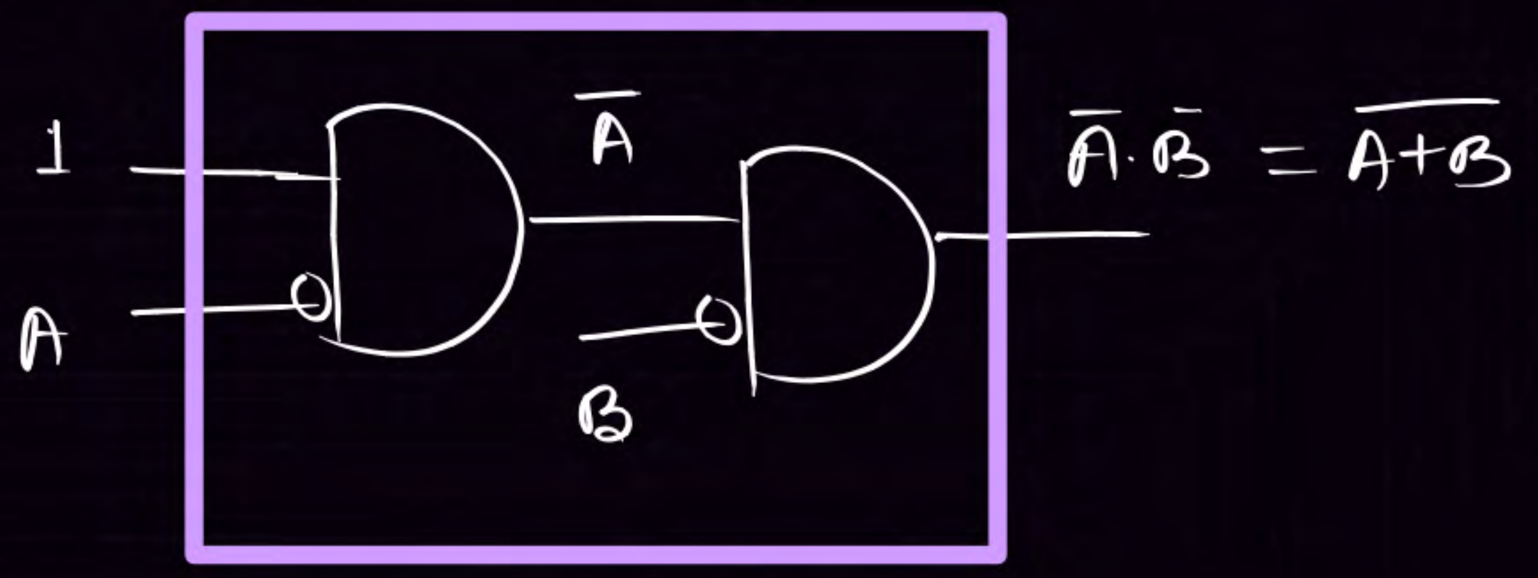
universal logic

$A\cdot\overline{B}$



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





NOR

$\overline{A \cdot B}$

$\overline{A+B}$

Expression

universal

Universal Logic

$\overline{A \cdot B}$

$\overline{A + B}$

$A \cdot \overline{B}$

$\overline{A} \cdot B$

$A + \overline{B}$

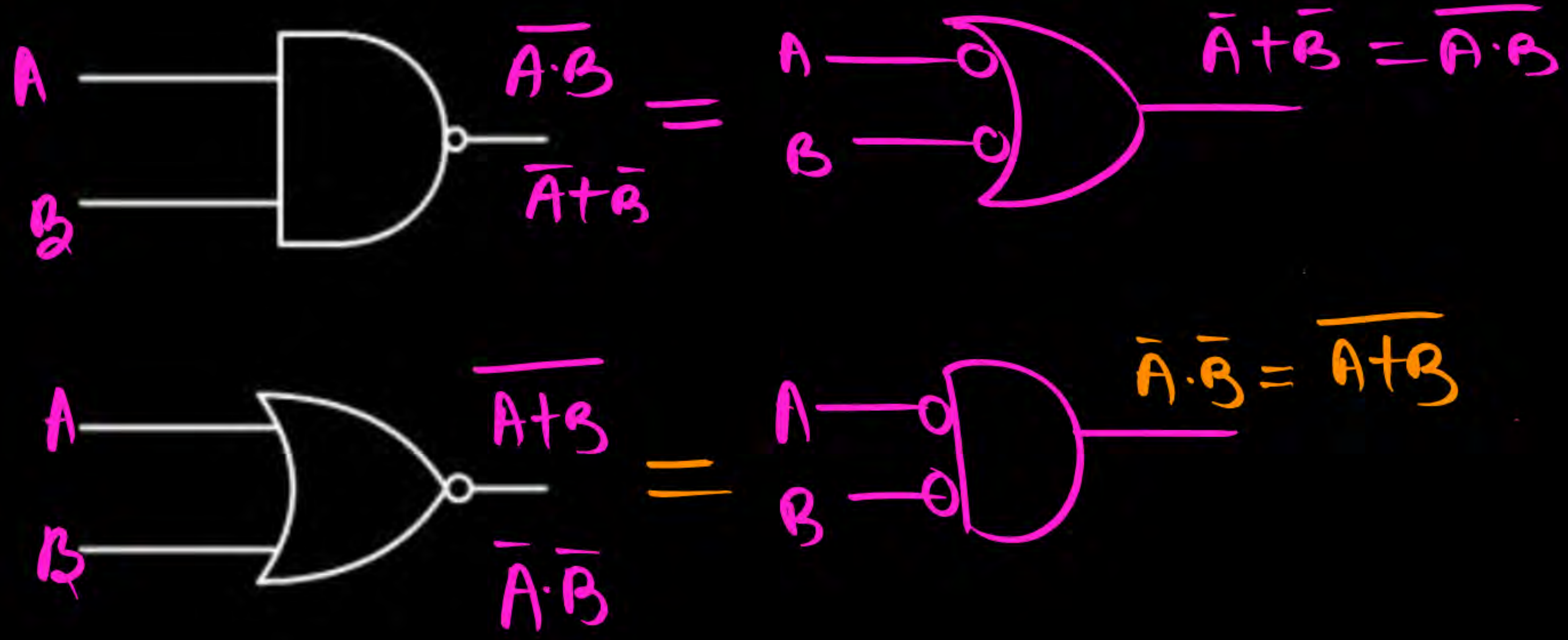
$\overline{A} + B$

MUX

DECODER + OR

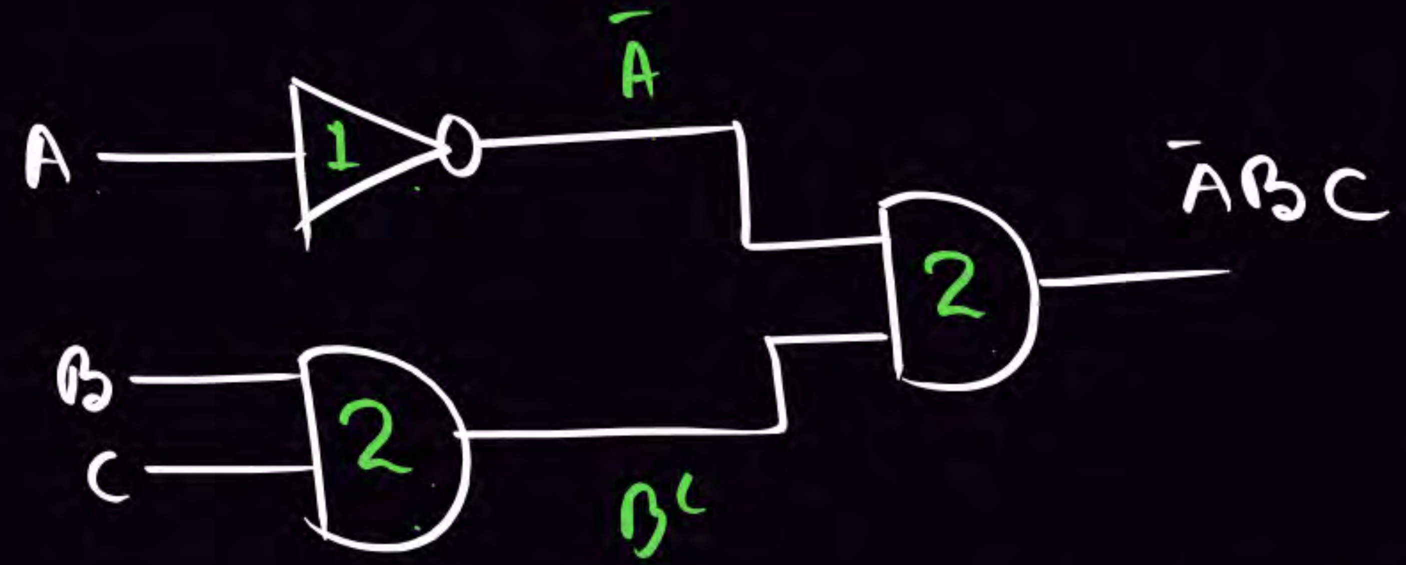
NAND, NOR GATE

- Alternate Symbol

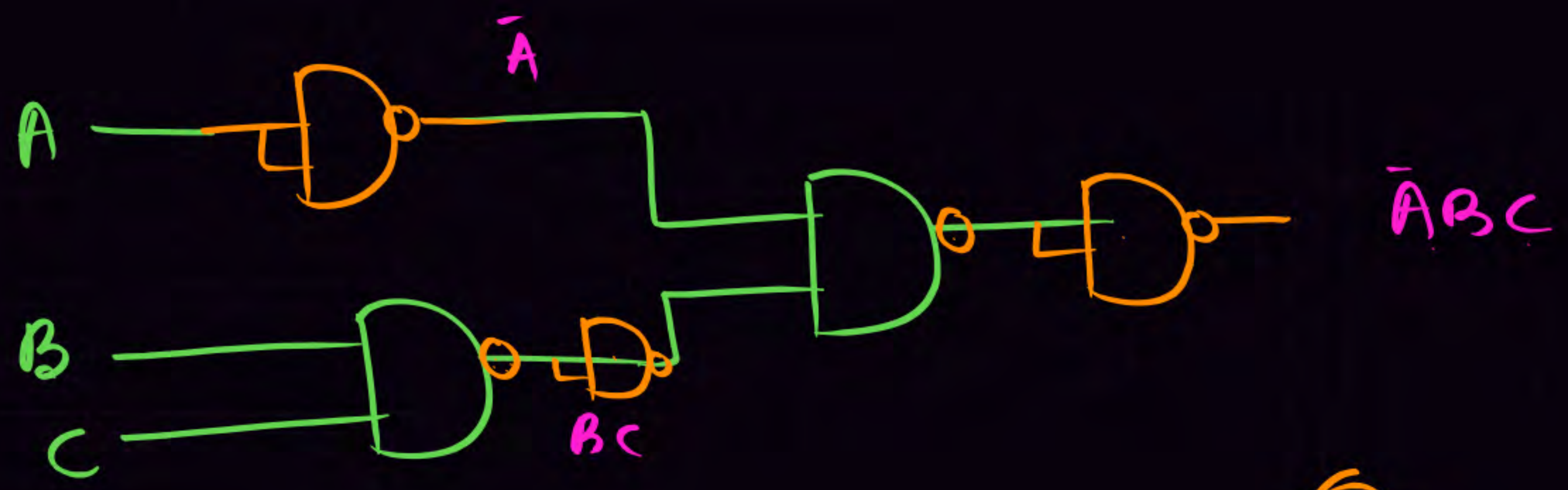


Q Find the minimum number of Two input NAND GATE required to Implement the function given below-

$$f(A,B,C) = \bar{A}BC$$



$1+2+2 = 5$ Ans



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TYPE (1)

$f = \bar{A} \cdot B \cdot \bar{C} \cdot D \cdot E \cdot F \cdots\cdots$

Minimum no. of NAND $= (2n-2)+K$

Minimum no. of NOR $= (3n-3)-K$

$n \rightarrow$ Total no. of Variables

$K \rightarrow$ Total no. of complement Variables

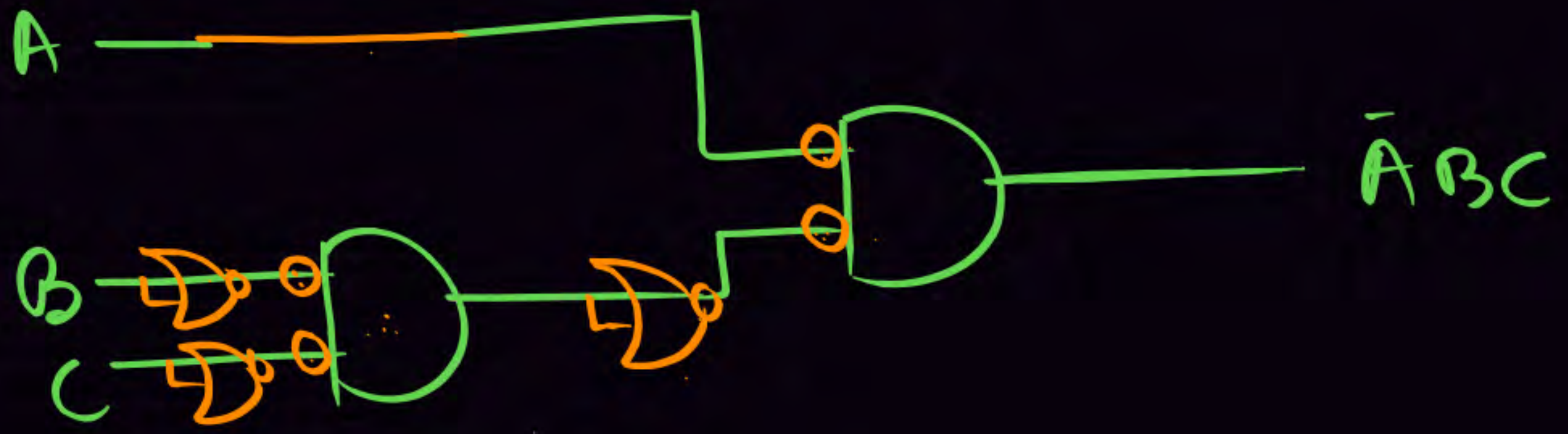
Ex $f = \bar{A}BC$

NAND	NOR
$(2n-2)+K$	$(3n-3)-K$
$n=3 \quad K=1$	$n=3 \quad K=1$
$(2\times3-2)+1$	$(3\times3-3)-1$
5	5

$f = \bar{A}BC$

NOR = ?

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



Ans = 5

$$f = \bar{A} \cdot B \cdot \bar{C} \cdot D$$

$$n = 4 \quad K = 2$$

$$NAND = (2n-2) + K$$

$$(2 \times 4 - 2) + 2$$

$$8$$

Ans

$$NOR = (3n-3) - K$$

$$= (3 \times 4 - 3) - 2$$

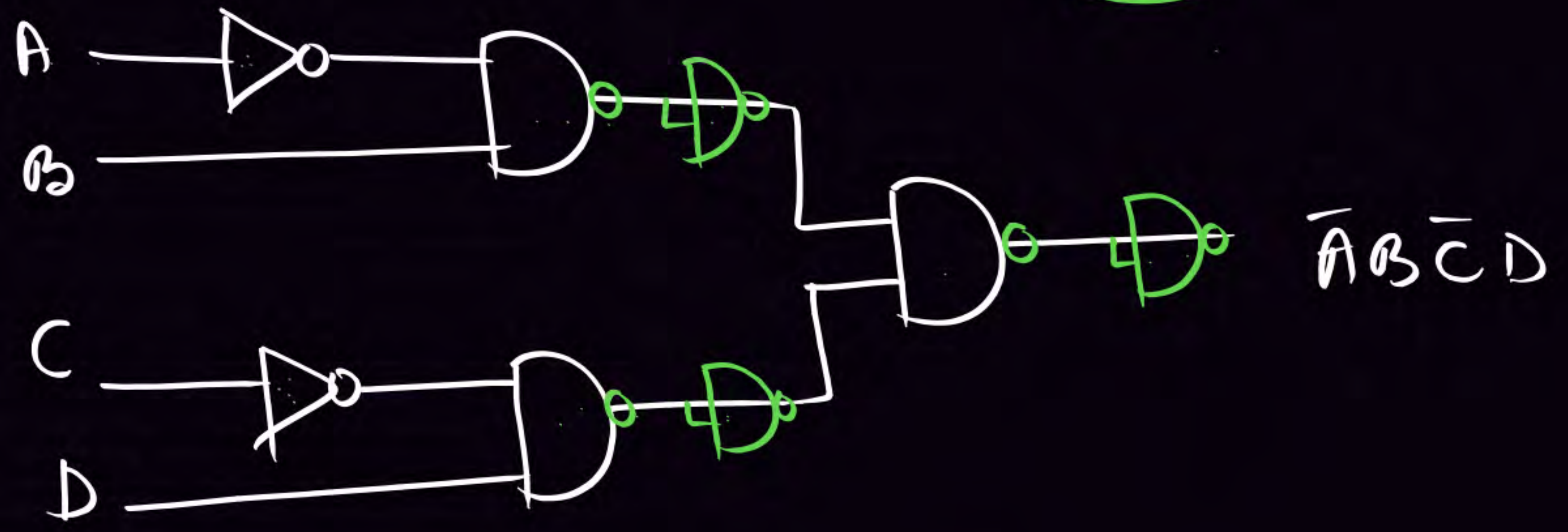
$$\Rightarrow 12 - 3 - 2$$

$$\Rightarrow 7$$

Ans

$f = \bar{A}B\bar{C}D$

NAND



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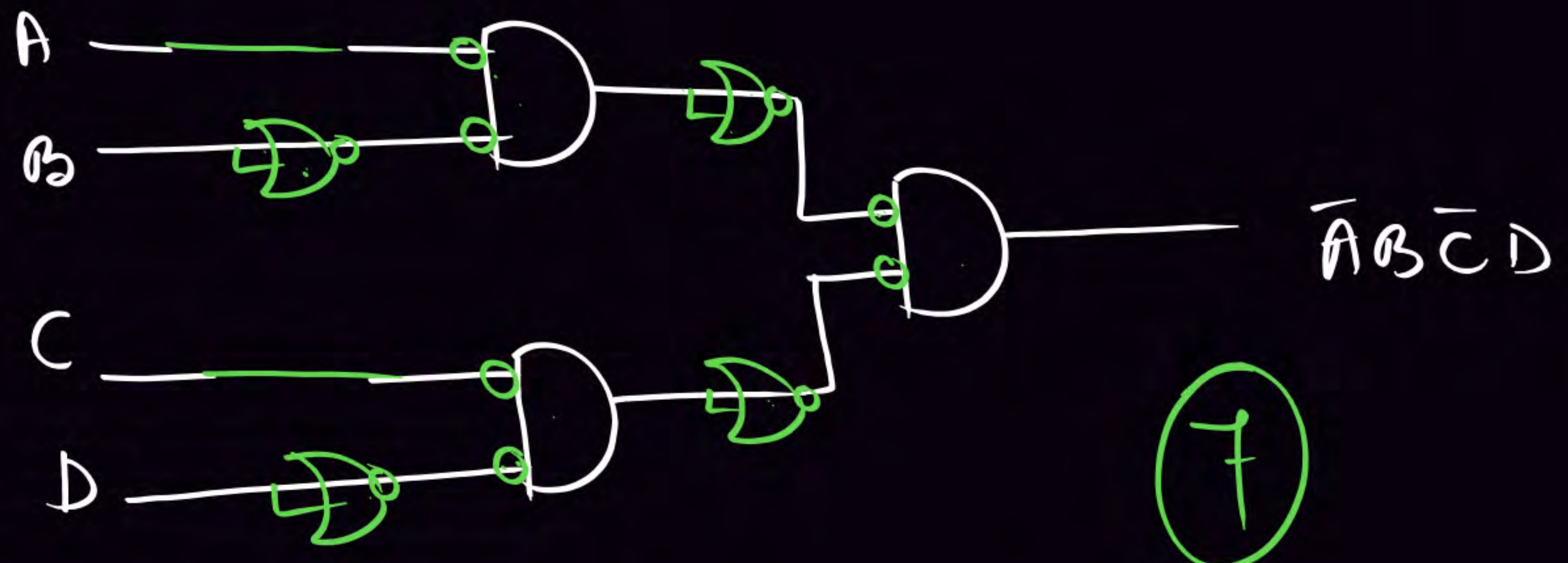
Ans

$f = \bar{A}B\bar{C}D$

NOR



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HW

$f = \bar{A} \cdot \bar{B} \cdot \bar{C} \cdot D \cdot E$

NAND = ?

NOR = ?

Thank you

GW

Soldiers !