COMPUTER SCIENCE & IT

DIGITAL LOGIC

Lecture No. 03

BOOLEAN THEOREMS AND GATES

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Boolean Theorems & Questions Discussion

Logic gates

- $AB + A\bar{B}C = A[B + \bar{B}C] = A[(B+\bar{B})\cdot(B+C)] = A\cdot(B+C) = AB + AC$

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

$= P + \bar{P}B = (P+\bar{P})\cdot(P+B) = (P+B)$

$= \bar{A}C + B$

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

- $(A+B+CD)\ (\bar{A}+B+\bar{C}D)(\bar{A}+B+C)$

$(A+B+CD)\ (\bar{A}+B+\bar{C}\cdot D\cdot C)$

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

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

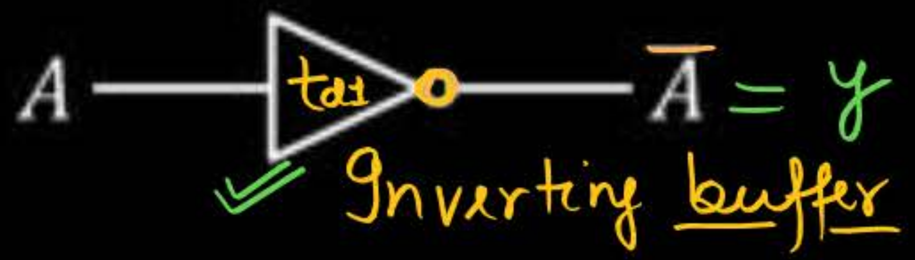
$= \underline{\underline{B+\bar{A}CD}} = (\bar{A}+B)\cdot(B+C)\cdot(B+D)$

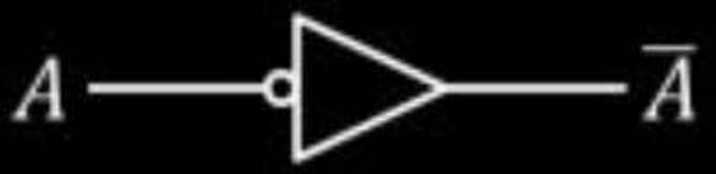
GATES

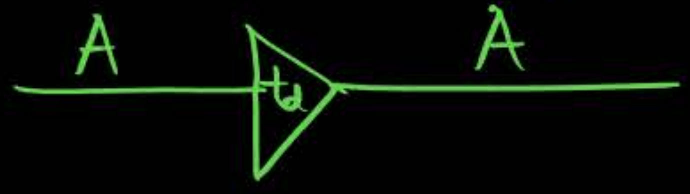
- Basic Gates : NOT, OR, AND
- Arithmetic Gates : XOR & XNOR
- Universal Gates : NAND & NOR

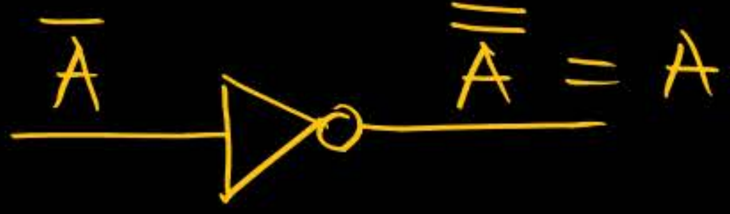
NOT GATE

Representation of NOT GATE :



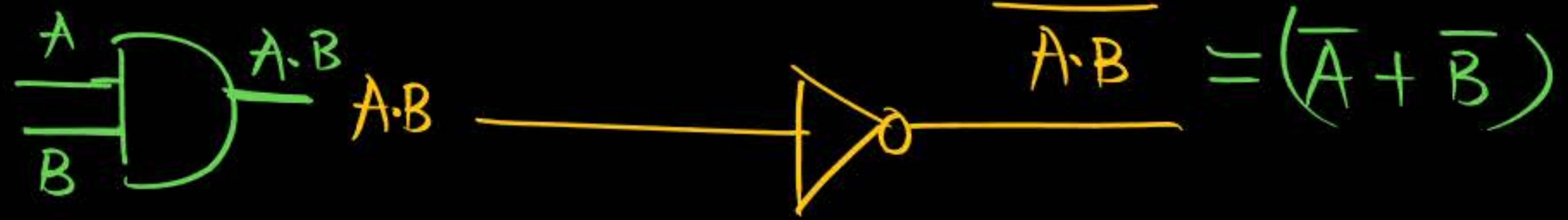






	Input A	Output Y
0	0	1
1	1	0

$\boxed{\text{TOCCI}}$



$$y(A) = \Sigma(0) = \pi(1)$$
$$= \overline{A} \quad = \overline{A}$$

AND GATE

Representation :

	2^1 A	2^0 B	Output $y = A.B$
0	0	0	0
1	0	1	0
2	1	0	0
3	1	1	1

$$y(A,B) = \Sigma 3 = \pi(0,1,2) = (A+B)\cdot(A+\bar{B})\cdot(\bar{A}+B)$$

$$= \underline{\underline{A\cdot B}}$$

$$= [A + B\cdot\bar{B}][\bar{A}+B]$$

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

$$= \underline{\underline{A\cdot B}}$$

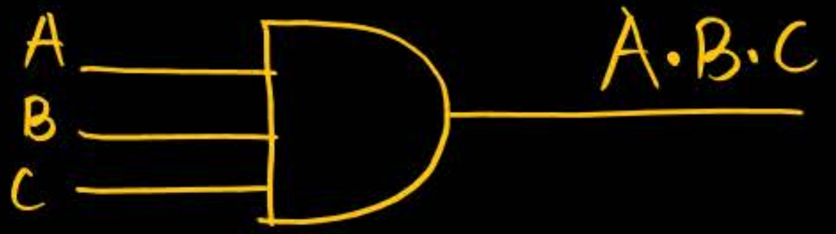
- Commutative Law :

$$\boxed{A \cdot B = B \cdot A}$$

It holds commutative law.

order of the variable is not important.

- Associative Law :



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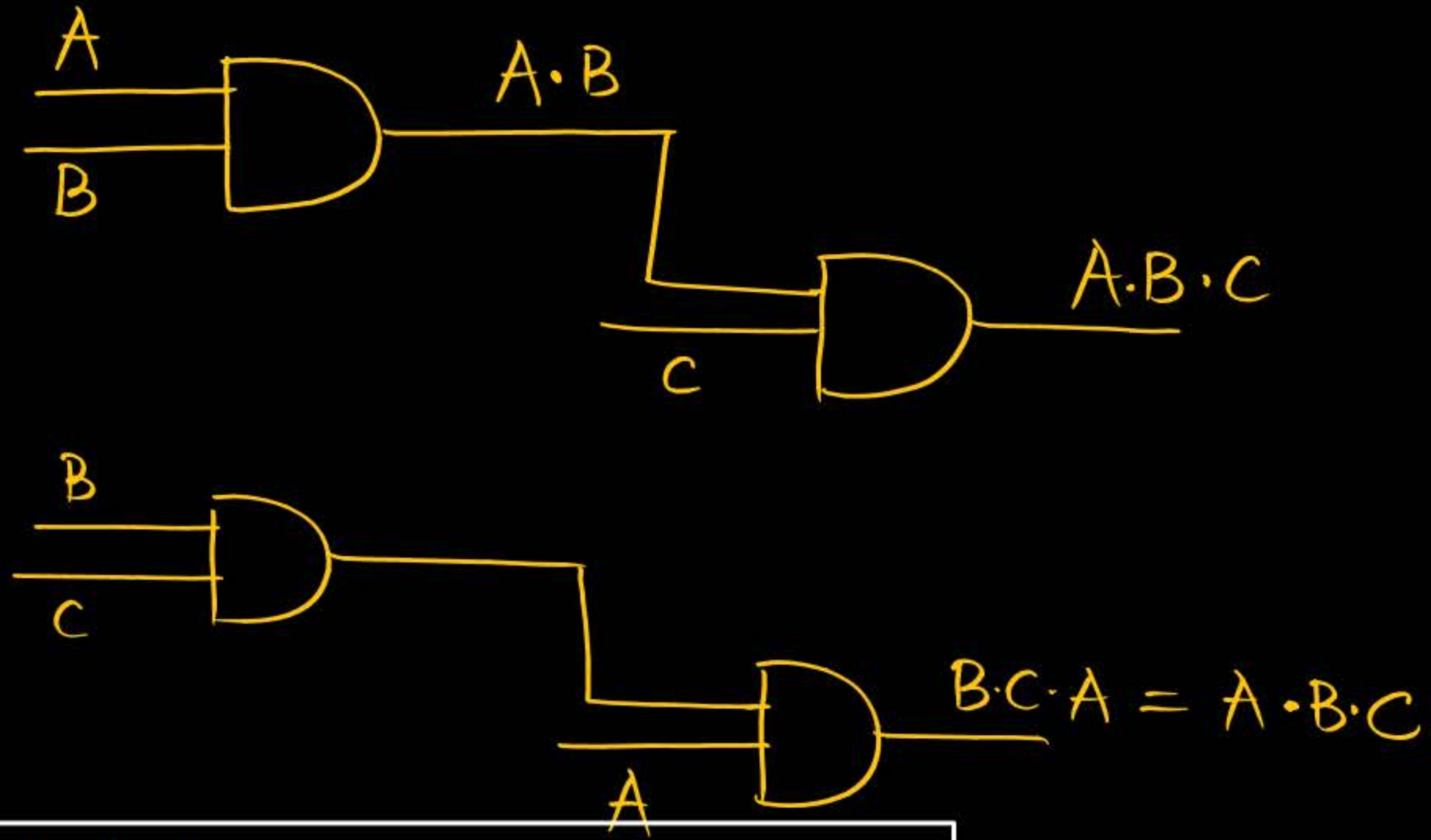
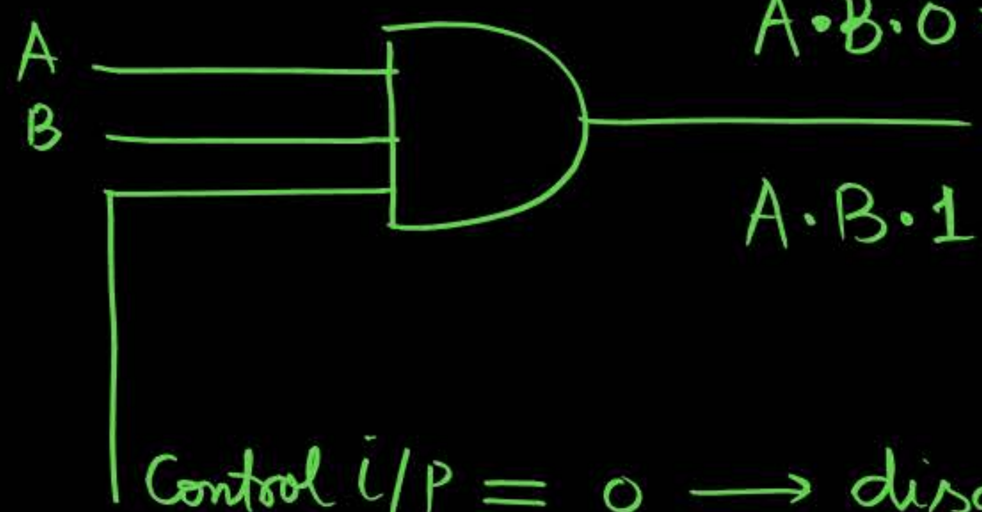


It holds associative law.

→ Multi i/P AND gate can be constructed using 2-i/P AND gates.

- Enable and Disable input for AND gate :



$A \cdot B \cdot 0 = 0$

$A \cdot B \cdot 1 = A \cdot B$

Control i/P $= 0 \longrightarrow$ disable

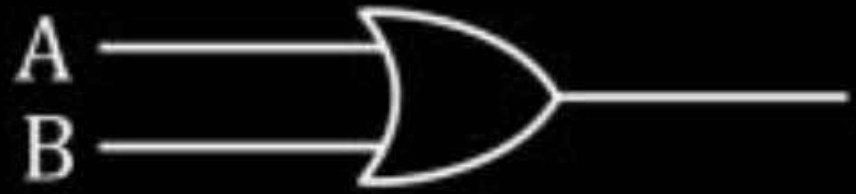
$= 1 \longrightarrow$ enable

- IMP points :

- If any one of i/p line is at logic '0', then irrespective of other i/p lines O/P will be '0'.
- O/P will be '1' in only one case when all the i/p lines will be at logic '1'.

OR GATE

Representation :



$A + B = y$

	A	B	$y = A + B$
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	1

$$y(A,B) = \Sigma(1,2,3) = \pi(0) = (A+B)$$

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

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

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

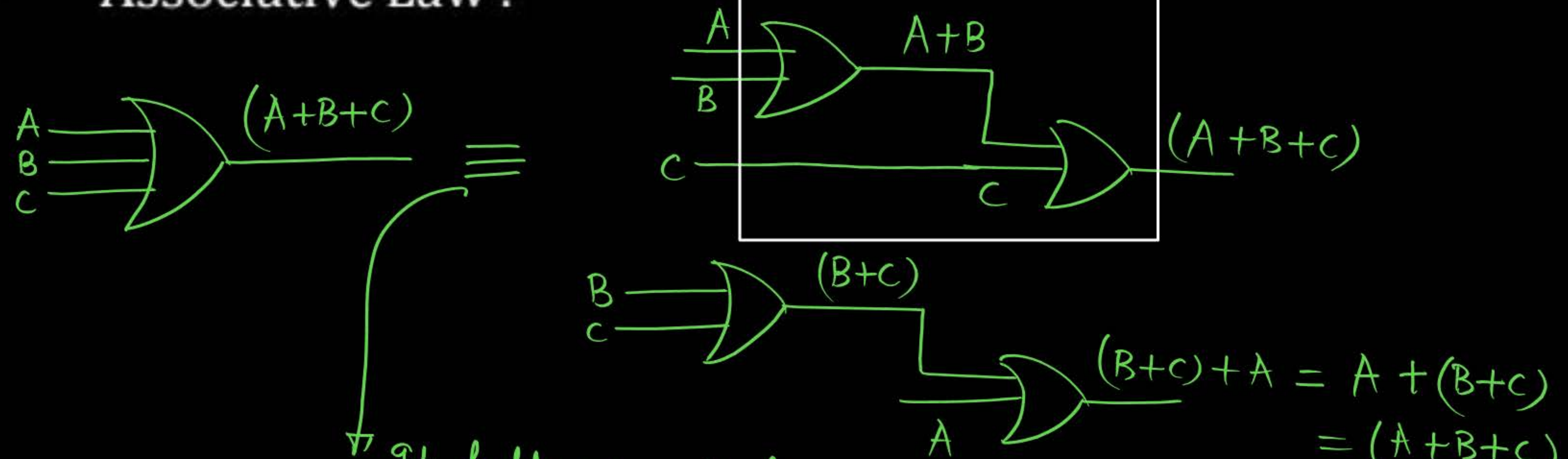
$$= (A+\bar{A})\cdot(A+B) = (A+B)$$

- Commutative Law :

It holds commutative law.

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

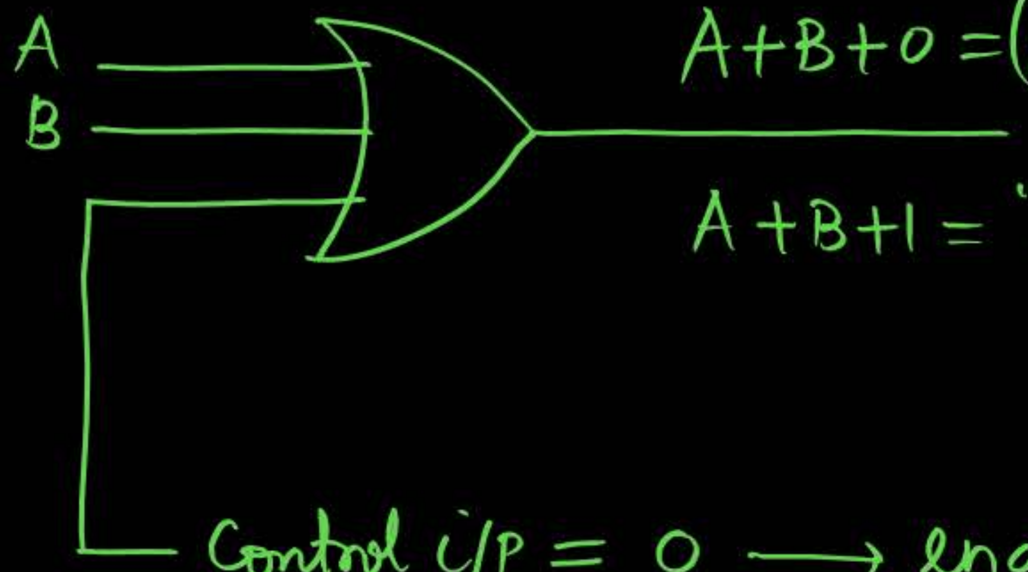
- Associative Law :



It holds associative law.

- Multi i/P OR gate can be constructed using 2-i/P OR gates.

- Enable and disable input for 'OR gate' :



$A+B+0=(A+B)$

$A+B+1='1'$

Control i/P $= 0 \longrightarrow$ enable

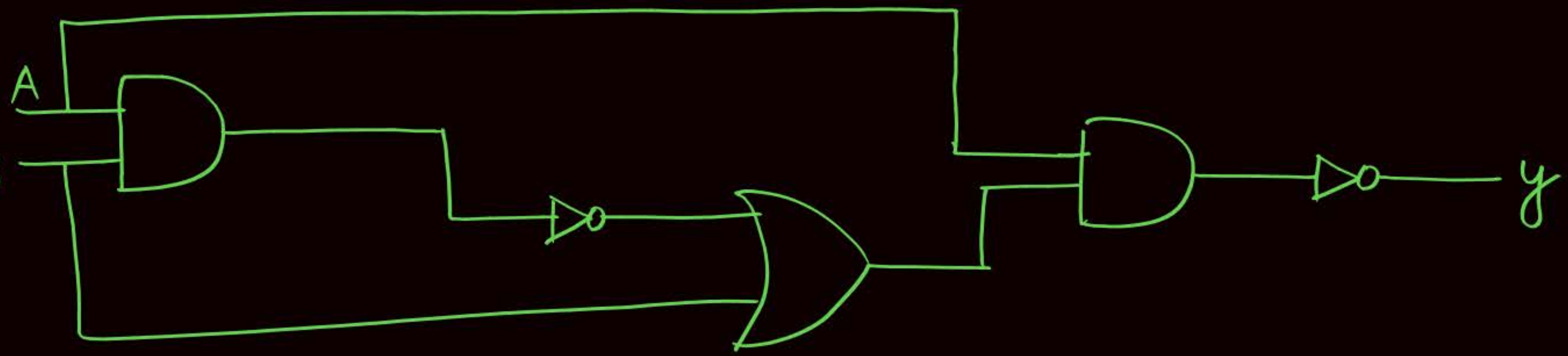
$= 1 \longrightarrow$ disable

- IMP Points :

- If any one of the i/p line is at logic '1' then irrespective of other i/p lines o/p will be '1'.
- o/p will be '0' only in one case when all the i/p lines will be at logic '0'.

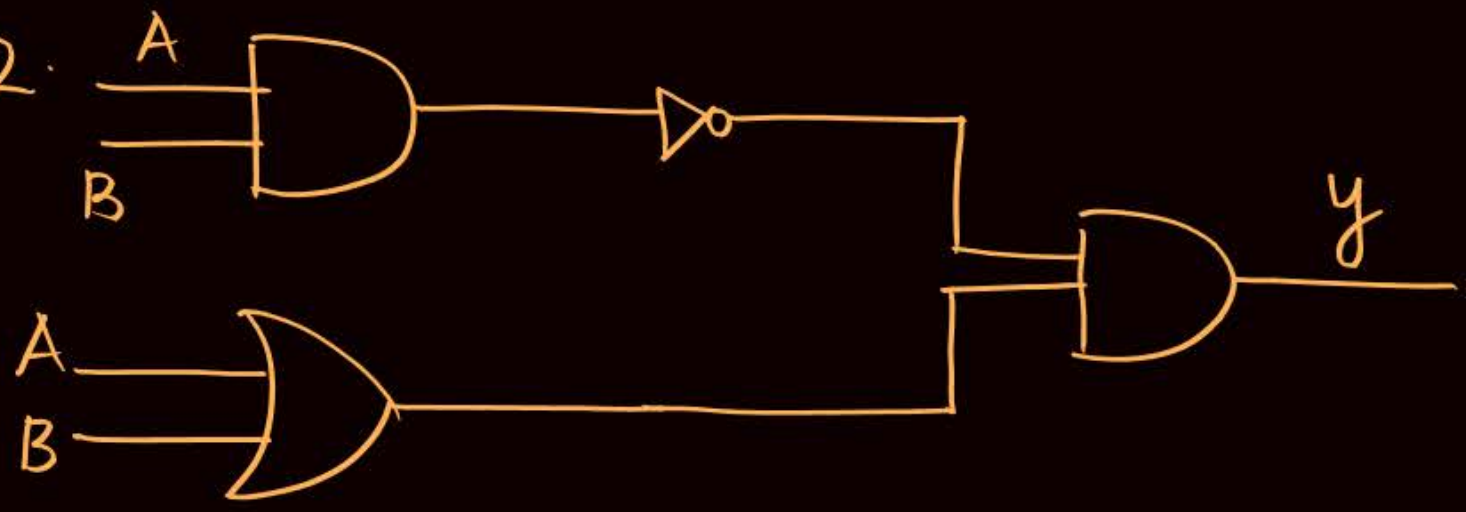
H.W.

Q.1.



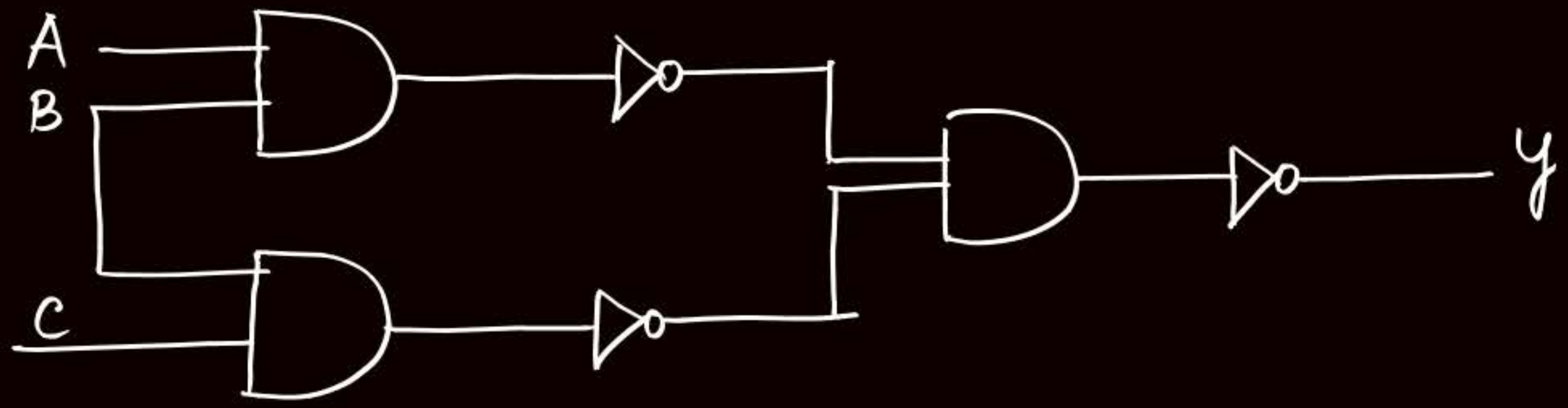
O/P y of the ckt ?

Q.2.



find O/P the y in SOP and POS format.

Q.



→ find out the O/P y and implement it using AND & OR only.

2 Minute Summary

→ Basic gates & its properties.

Thank you

GW Soldiers !