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Comprehensive Course on Digital Electronic Circuit for 2021

Laws and Theorems in Boolean Algebra

Lesson 1 • June 11, 2020 • Sonu Lal Gupta

#. Boolean Algebra ⇒ 2-Marks

Logic Gates ⇒ BJT | MOSFET | Diode | Switching ⇒ 1 maks

Combinational ckt ⇒ 2marks

Coding s/m | Number | 2's complement ⇒ ~~2~~ marks

Sequential ⇒ 2 Marks

ADC-DAC ⇒ 1marks

6-8 Marks

2018 ⇒ 13 Marks

Digital

#. Laws & theorems

① Idempodent Law :- $\boxed{A \cdot \bar{A} = 0}$

② Commulative Law :- $AB = BA$, $A + B = B + A$,
$A \oplus B = B \oplus A$

③ Associative Law :-

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

④ Distributive Law :-

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

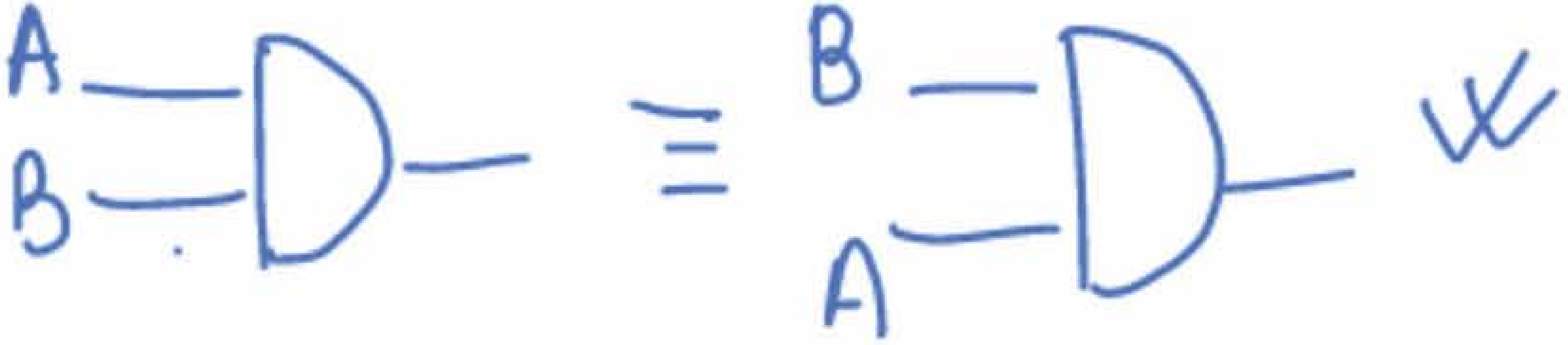
① Idempodent Law :-

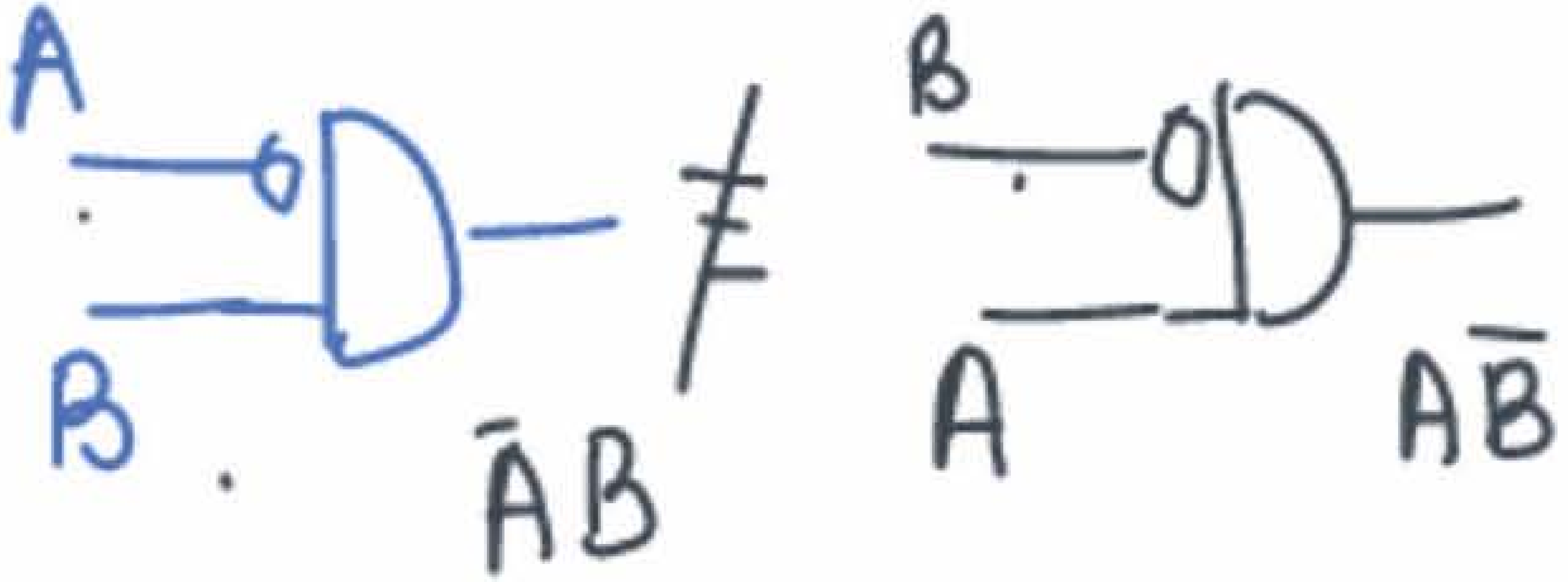
$A \cdot \bar{A} = 0$

ⓐ $A = 0 \Rightarrow 0 \cdot 1 = 0$

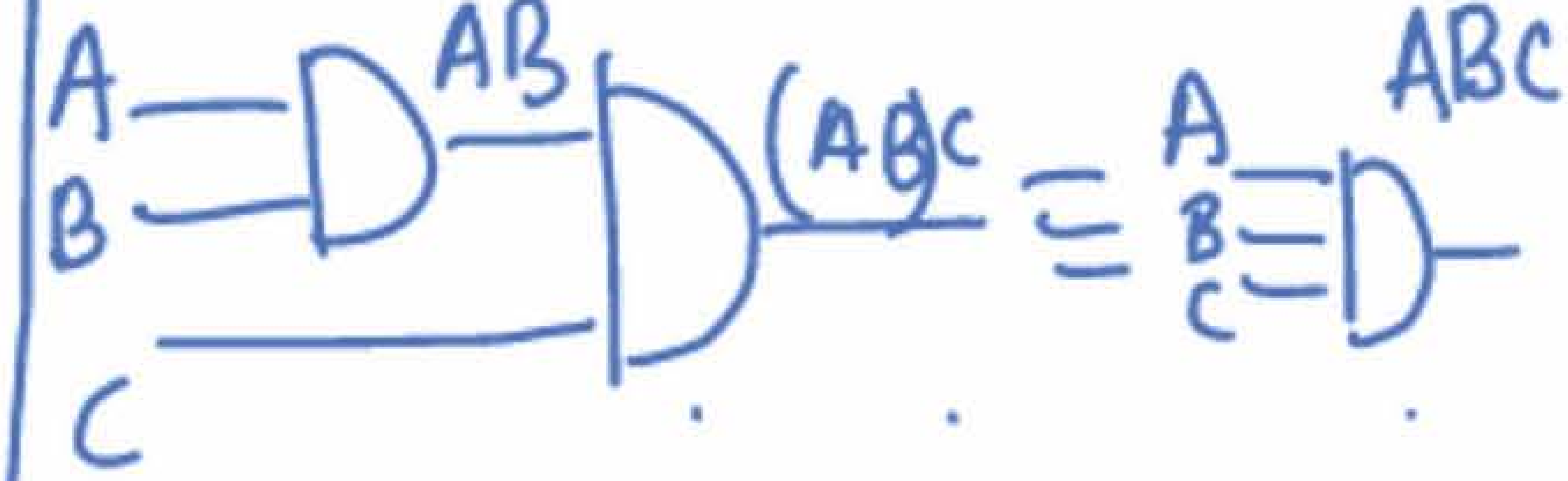
ⓑ $A = 1 \Rightarrow 1 \cdot 0 = 0$

② Commutative Law :-





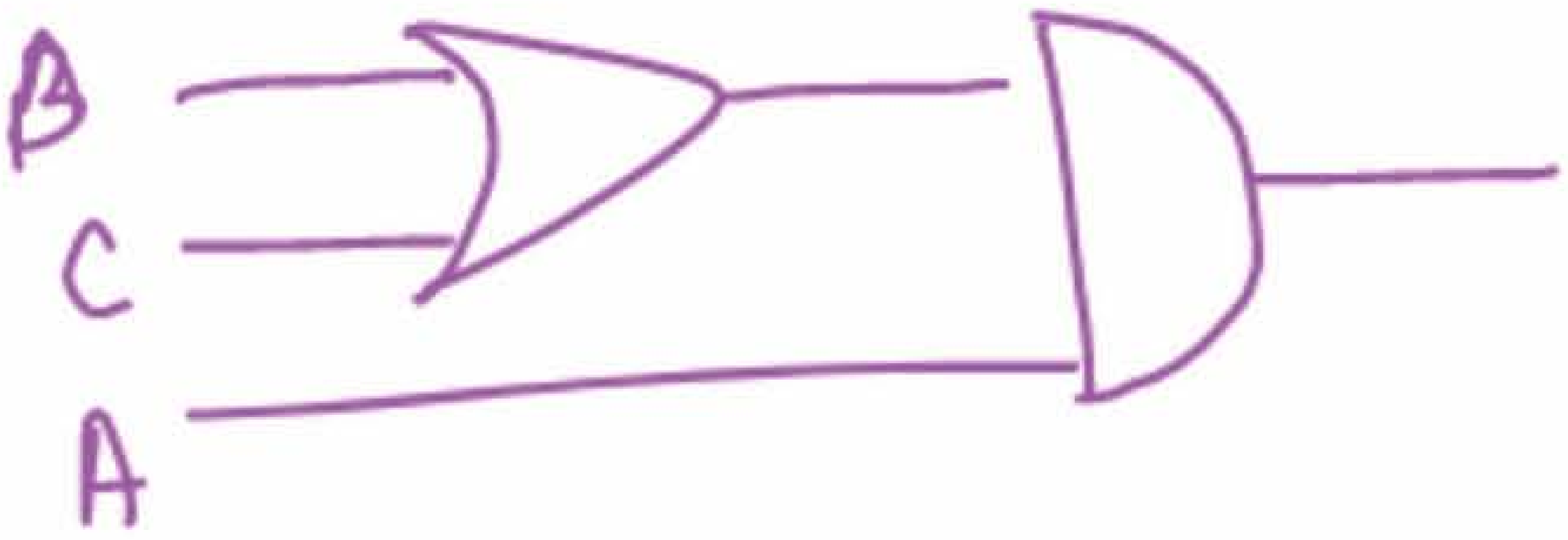
③ Associative Law :-



$\equiv (A \odot B) \odot C$

$A \odot B \odot C$

$A(B+C)$



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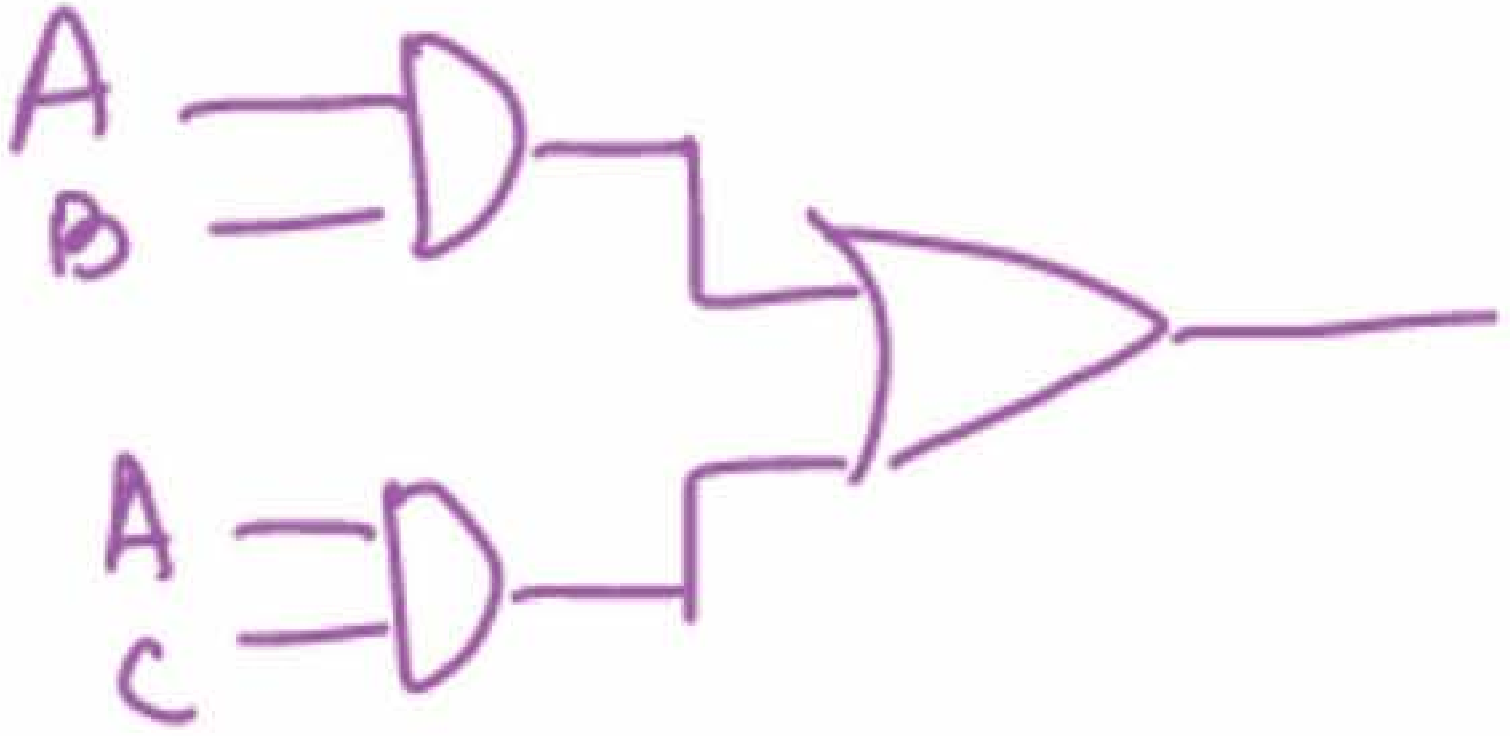
$AB + AC$



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⑤ Distribution theorem :-

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

⑥ Transposition theorem:-

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

⑦ Consensus theorem :-

$$AB + AC + \overline{B}C = AB + \overline{B}C$$

#. Some imp. point :-

NOT / OR / AND / NAND / NOR

$\Downarrow$

Boolean

$0+0=0$	$0+0=0$
$0+1=1$	$0+1=1$
$1+0=1$	$1+0=1$
$1+1=1$	$1+1=0$
OR	X-OR / X-NOR $\Rightarrow$ Binary gates
boolean Algebra	Binary algebra

$1+1=2$

$\downarrow$

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.

$$
\left.\begin{aligned}
0 \cdot 0 &= 0 \\
0 \cdot 1 &= 0 \\
1 \cdot 0 &= 0 \\
1 \cdot 1 &= 1
\end{aligned}\right] \Rightarrow \text{Binary} \mid \text{Boolean}
$$

⑧ Law of adjancy :- $(A+B)(\bar{A}+B) = B$

⑨ Demorgan's theorem :-

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

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

#

(a) $0 + 0 = 0$

$0 + 1 = 1$

$1 + 0 = 1$

$1 + 1 = 1$

(b) $0 \cdot 0 = 0$

$0 \cdot 1 = 0$

$1 \cdot 0 = 0$

$1 \cdot 1 = 1$

(c) $A + 0 = A$

$A + 1 = 1 \rightarrow 0 + 1 = 1$

$\rightarrow 1 + 1 = 1$

$A + \overline{A} = 1 \rightarrow 0 + 1 = 1$

$\rightarrow 1 + 0 = 1$

$A + A + A + A + \cdots = A$

(d) $A \cdot 0 = 0$

$A \cdot 1 = A$

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

$A \cdot A \cdot A \cdot A \cdot \cdots = A$

Distribution theorem:- POS $\rightleftharpoons$ SOP

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

$$① + ② \quad ① + ③ = ① + ②③$$

proof:-

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

$$= A + AC + AB + BC$$

$$= A(1 + \underbrace{C+B}) + BC = A \cdot 1 + BC = A + BC$$