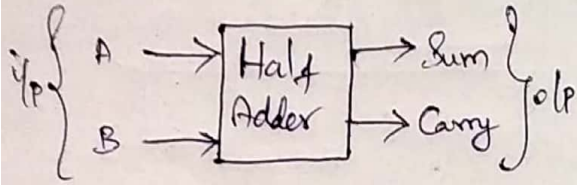


# COMBINATIONAL CIRCUIT DESIGN

## HALF ADDER



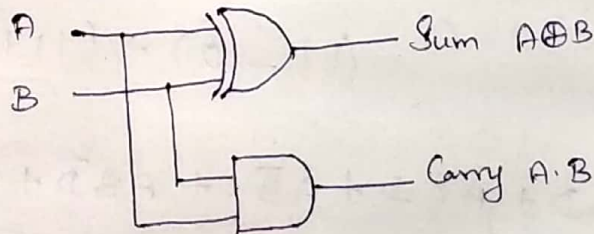
I/P		O/P	
A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

A	$\bar{B}$	B
0	0	1
0	0	0
1	0	1

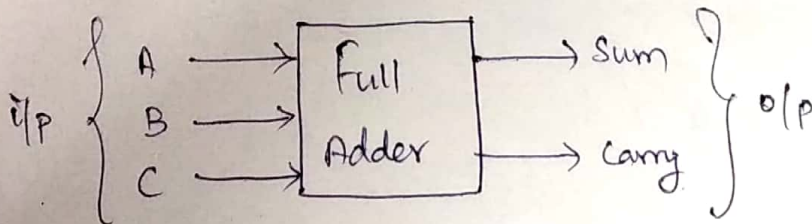
Carry =  $AB$

A	$\bar{B}$	B
0	0	1
1	0	0

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

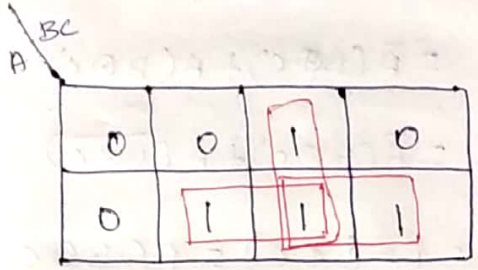


## FULL ADDER

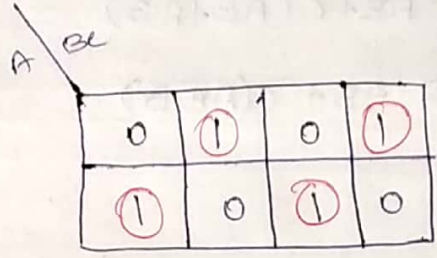


Inputs                      Outputs.

A	B	C	Carry	Sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1



Carry =  $AB + BC + AC$



Sum =  $\bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$

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

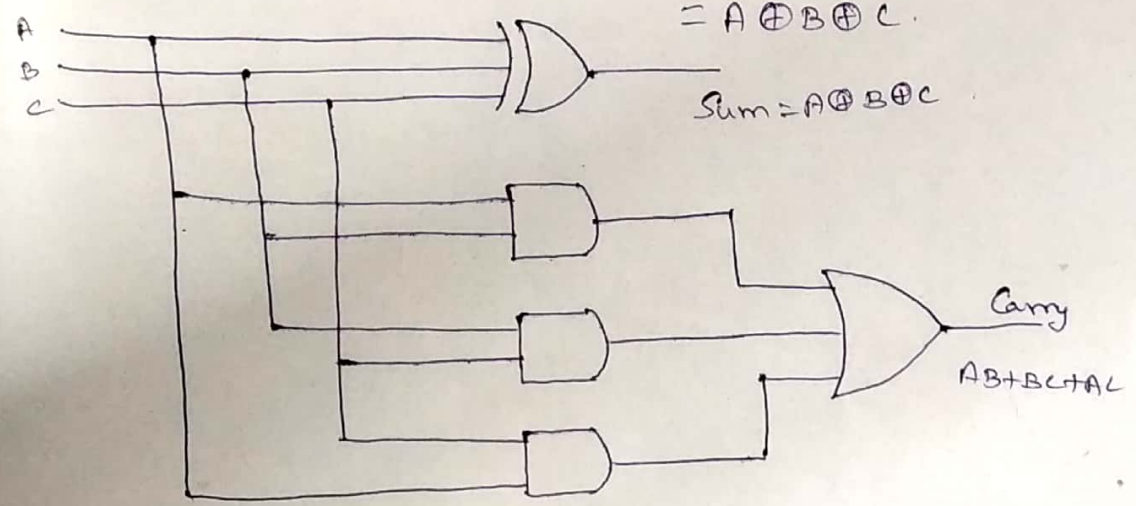
$= \bar{A}(B \oplus C) + A(B \odot C)$

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

$= A \oplus (B \oplus C)$

$= A \oplus B \oplus C$

Sum =  $A \oplus B \oplus C$



# Full Adder Using Half Adder

A	BC		
0	0	1	0
0	1	1	1

$$\begin{aligned} \text{Carry} &= A\bar{B}c + \bar{A}Bc + AB \\ &= AB + c(A\bar{B} + \bar{A}B) \\ &= AB + c(A \oplus B) \end{aligned}$$

A	BC		
0	1	0	1
1	0	1	0

$$\begin{aligned} \text{Sum} &= \bar{A}\bar{B}c + \bar{A}B\bar{c} + A\bar{B}\bar{c} + ABC \\ &= \bar{A}(\bar{B}c + B\bar{c}) + A(\bar{B}\bar{c} + Bc) \\ &= \bar{A}(B \oplus c) + A(\bar{B} \oplus \bar{c}) \\ &= \bar{A}(B \oplus c) + A(\overline{B \oplus c}) \\ &= A \oplus (B \oplus c) = A \oplus B \oplus c \end{aligned}$$

