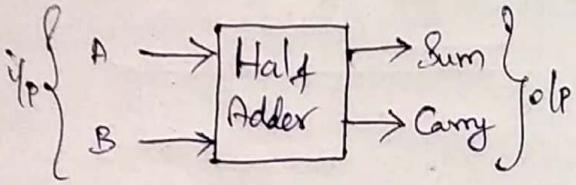
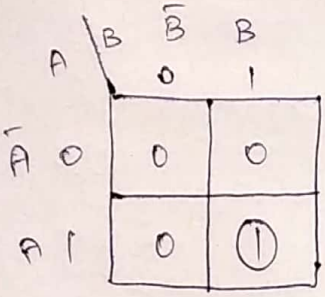
Combinational Circuit Design

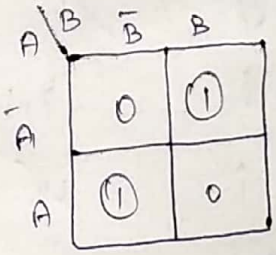
Half Adder



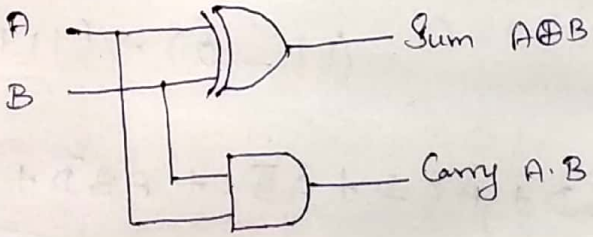
I/p		o/p	
A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0



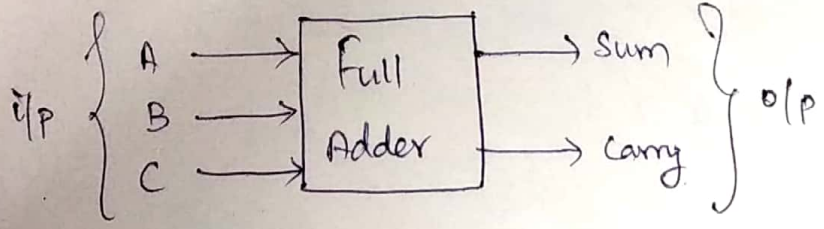
Carry = AB



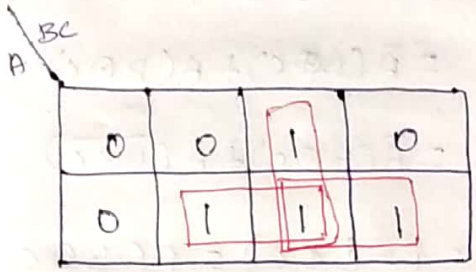
Sum = $A\bar{B} + \bar{A}B = A \oplus B$.

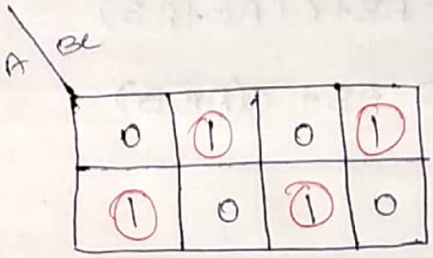


Full Adder



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

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

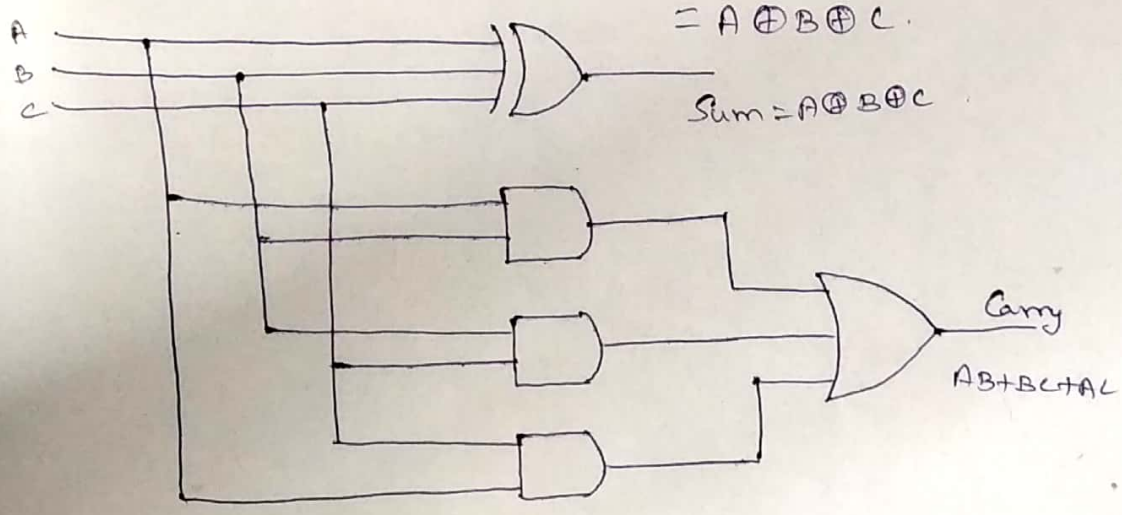
$= \bar{A}(B\oplus C)+A(B\odot C)$

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

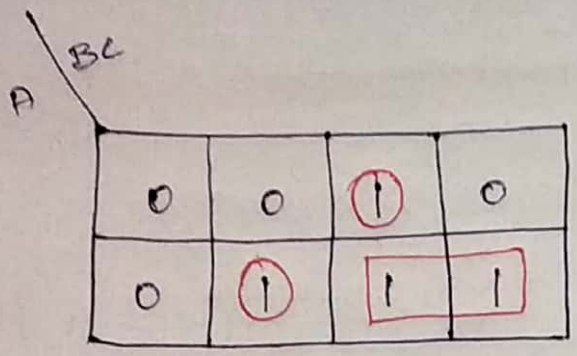
$= A\oplus(B\oplus C)$

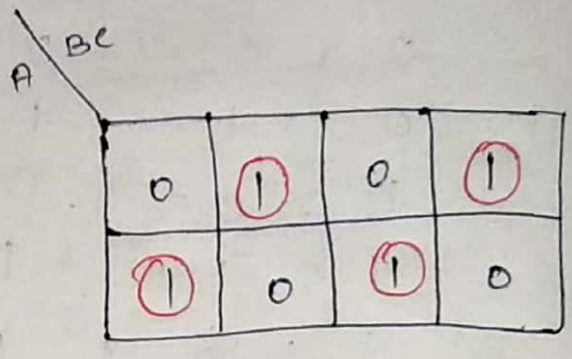
$= A\oplus B\oplus C$

Sum = $A\oplus B\oplus C$



Full Adder Using Half Adder





$$\text{Carry} = A\bar{B}C + \bar{A}BC + AB$$

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

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

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

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

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

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

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