Electronics

MSc. Physics Semester 2

Paper - MPHY CC-7

Unit 4

Topic – Half Adder and Full Adder

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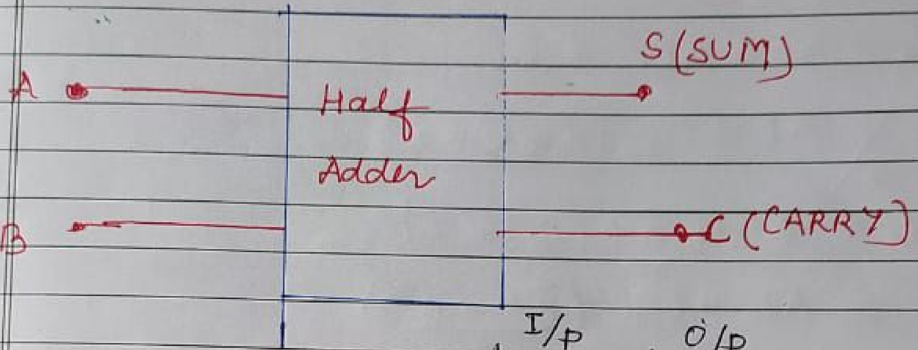
Half Adder

A logic circuit for the addition of two one bit number is called Half Adder.



2^n

n = no of input

$2^2 = 4$

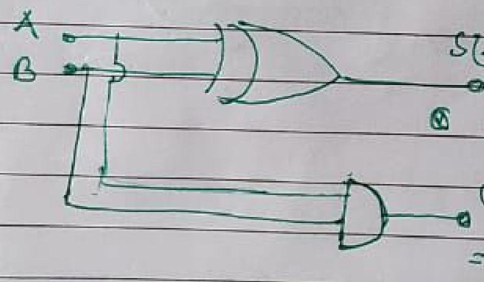
I/P		O/P	
A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

SUM

B \ A	0	1
0	0	1
1	1	0

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

$C = AB$



$S = A \oplus B$

$= AB.$

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Full Adder

A full adder is a combinational circuit that adds two bit and carry and outputs a sum bit, and a carry bit.

It has two input and two output

$2^n = 2^3 = 8$

A	B	C_{in}	S	C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

K-map for S

C_{in} \ AB	00	01	11	10
0	0 (0)	1 (2)	0 (6)	1 (4)
1	1 (1)	0 (3)	1 (7)	0 (5)

$$S = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + ABC_{in} + A\bar{B}\bar{C}_{in}$$

$$= \bar{A}\bar{B}C_{in} + ABC_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in}$$

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

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

$$= \bar{X}C_{in} + X\bar{C}_{in}$$

$$= \underbrace{X \oplus C_{in}} = \boxed{A \oplus B + C_{in}}$$

K-map for C

C_{in} \ AB				
	0	0	1	0
	0	1	1	1

$$C = AB + AC_{in} + BC_{in}$$

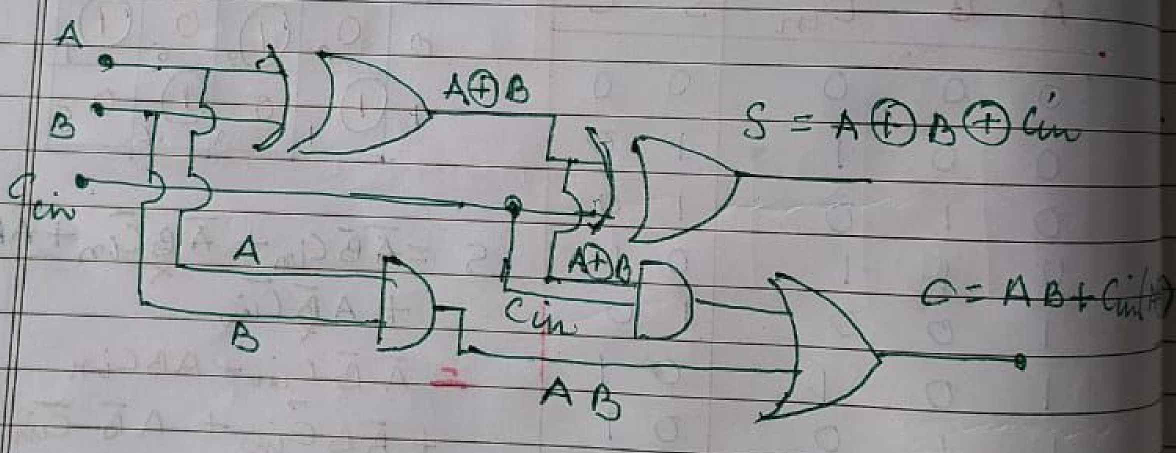
or, $C = AB + C_{in}(\bar{A} \oplus \bar{B})$

$$C = AB + \bar{A}BC_{in} + A\bar{B}C_{in}$$

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

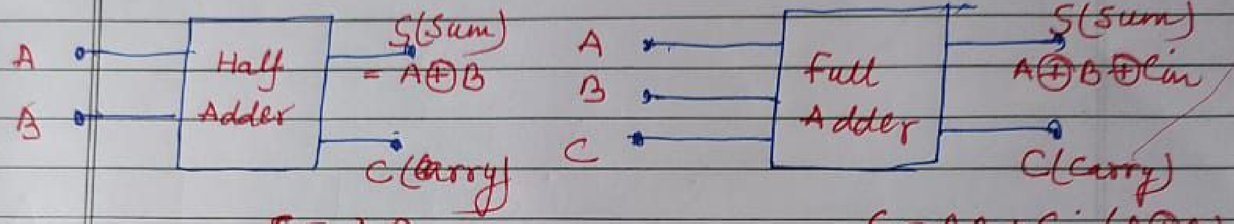
$$C = AB + C_{in}(A \oplus B)$$

$$S = A \oplus B \oplus C_{in}$$



Full Adder Using Half Adder

Half Adder Full Adder

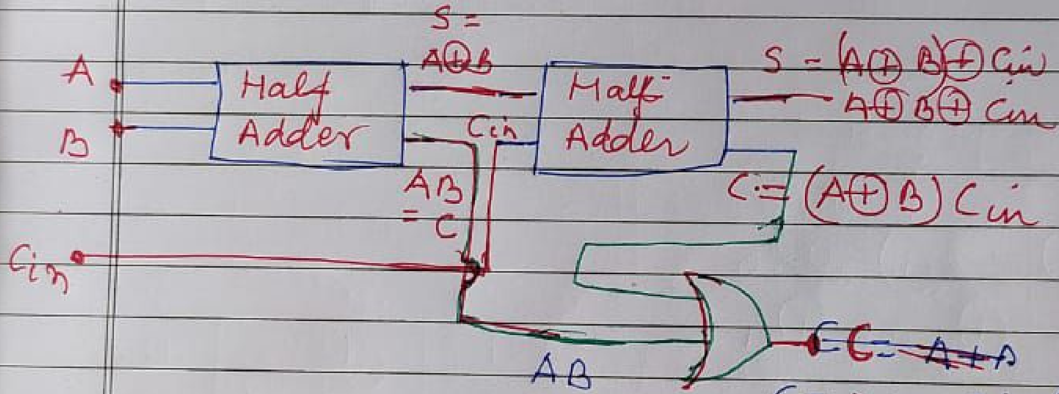


$S = A \cdot B$

$C = AB + C_{in}(A \oplus B)$

or,

$C = AB + BC_{in} + AC_{in}$



$C = AB + C_{in}(A \oplus B)$

$C = AB + C_{in}(A \oplus B)$

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

$= AB + A\bar{B}C_{in} + \bar{A}BC_{in}$

$= A(\underline{B + \bar{B}C_{in}}) + \bar{A}BC_{in}$ $[\because (A + \bar{A}B) = A + B]$

$= A(B + C_{in}) + \bar{A}BC_{in}$

$= AB + AC_{in} + \bar{A}BC_{in}$

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

$= AB + C_{in}(A + B)$

$\boxed{C = AB + AC_{in} + B \cdot C_{in}}$