Introduction

Adders are digital circuits that carry out addition of numbers. Adders are a key component of arithmetic logic unit. Adders can be constructed for most of the numerical representations like Binary Coded Decimal (BCD), Excess – 3, Gray code, Binary etc. out of these, binary addition is the most frequently performed task by most common adders. Apart from addition, adders are also used in certain digital applications like table index calculation, address decoding etc.

Binary addition is similar to that of decimal addition. Some basic binary additions are shown below.

0	0	1	1
+0	+1	+0	+1
0	1	1	(carry) 1 0

Figure 1. Schematic representation of half adder

1)Half Adder
Half adder is a combinational circuit that performs simple addition of two binary numbers. If we assume A and B as the two bits whose addition is to be performed,the block diagram and a truth table for half adder with A, B as inputs and Sum, Carry as outputs can be tabulated as follows.

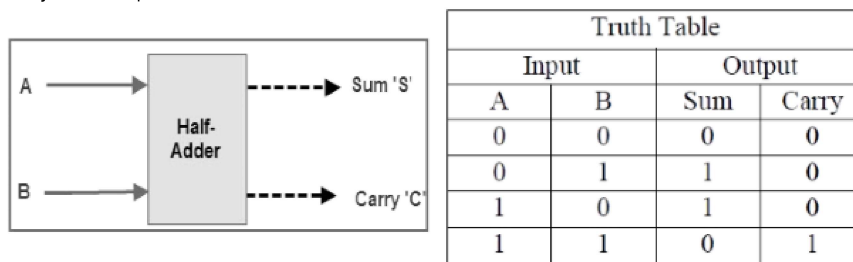| Truth Table			
Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Figure 2. Block diagram and truth table of half adder

The sum output of the binary addition carried out above is similar to that of an Ex-OR operation while the carry output is similar to that of an AND operation. The same can be verified with help of Karnaugh Map.
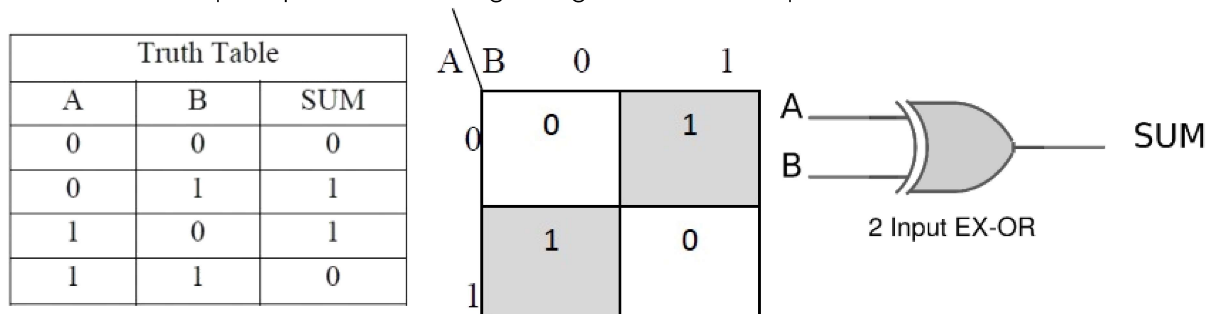The truth table and K Map simplification and logic diagram for sum output is shown below.

Truth Table		
A	B	SUM
0	0	0
0	1	1
1	0	1
1	1	0

Figure 3. Truth table, K Map simplification and Logic diagram for sum output of half adder

$$Sum = A B' + A' B$$

The truth table and K Map simplification and logic diagram for carry is shown below.

Truth Table