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Lab Experiment 3
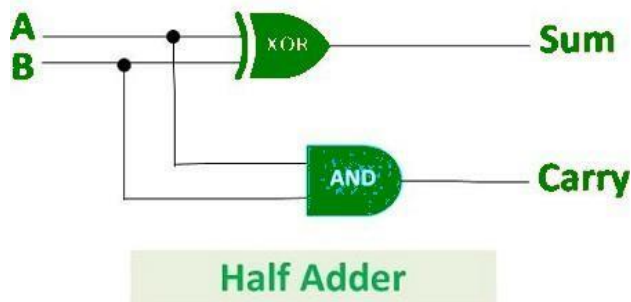
Aim: Realize Half adder and Full adder

LO No & Statement: LO2:

Hardware/Software Required: Logisim Software

Theory:

1. Half Adder :
   Half Adder is a combinational logic circuit which is designed by connecting one EX-OR gate and one AND gate. The half adder circuit has two inputs: A and B, which add two input digits and generates a carry and a sum.

Half Adder

The output obtained from the EX-OR gate is the sum of the two numbers while that obtained by AND gate is the carry. There will be no forwarding of carry addition because there is no logic gate to process that. Thus, this is called Half Adder circuit.

Logical Expression :

Sum = A XOR B

Carry = A AND B

Truth Table :

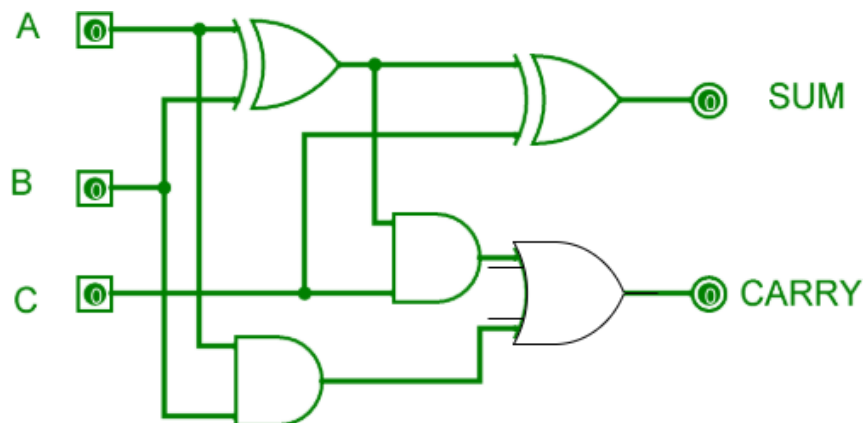| Truth Table			
Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

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2. Full Adder :

Full Adder is the circuit which consists of two EX-OR gates, two AND gates and one OR gate. Full Adder is the adder which adds three inputs and produces two outputs which consists of two EX-OR gates, two AND gates and one OR gate. The first two inputs are A and B and the third input is an input carry as C-IN. The output carry is designated as C-OUT and the normal output is designated as S which is SUM.

Equation obtained by EX-OR gate is the sum of the binary digits. While the output obtained by AND gate is the carry obtained by addition.

Truth Table :

Input			Output	
A	B	Cin	Sum	Carry
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

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Logical Expression :

SUM = (A XOR B) XOR Cin = (A $\oplus$ B) $\oplus$ Cin
CARRY-OUT = A AND B OR Cin(A XOR B) = A.B + Cin(A $\oplus$ B)

Difference Between Half Adder and Full Adder

| Parameter	Half Adder	Full Adder
Basics	The Half Adder is a type of combinational logic circuit that adds two of the 1-bit binary digits. It generates carry and sum of both the inputs.	The Full Adder is also a type of combinational logic that adds three of the 1-bit binary digits for performing an addition operation. It generates a sum of all three inputs along with a carry value.
Adding the Previous Carry	The Half Adder does not add the carry obtained from the previous addition to the next one.	The Full Adder, along with its current inputs A and B, also adds the previous carry.
Hardware Architecture	A Half Adder consists of only one AND gate and EX-OR gate.	A Full Adder consists of one OR gate and two EX-OR and AND gates.
Total Inputs	There are two inputs in a Half Adder-A and B.	There are a total of three inputs in a Full Adder-A. B. C-in.
Usage	The Half Adder is good for digital measuring devices, computers, calculators, and many more.	The Full Adder comes into play in various digital processors, the addition of multiple bits, and many more.
Logical Expression	Here is the logical expression of Half Adder: C = A * B S = A $\oplus$ B	Here is the logical expression of Full Adder: Cout = (AB) + CinA $\oplus$ CinB S =A $\oplus$ B $\oplus$ Cin

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Diagram using Logisim Software:

Half Adder:
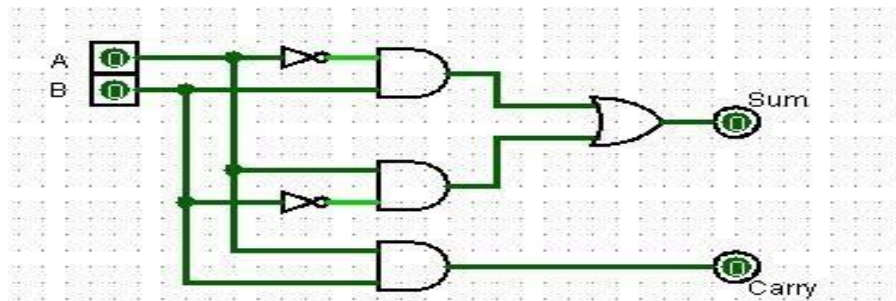
Full Adder:
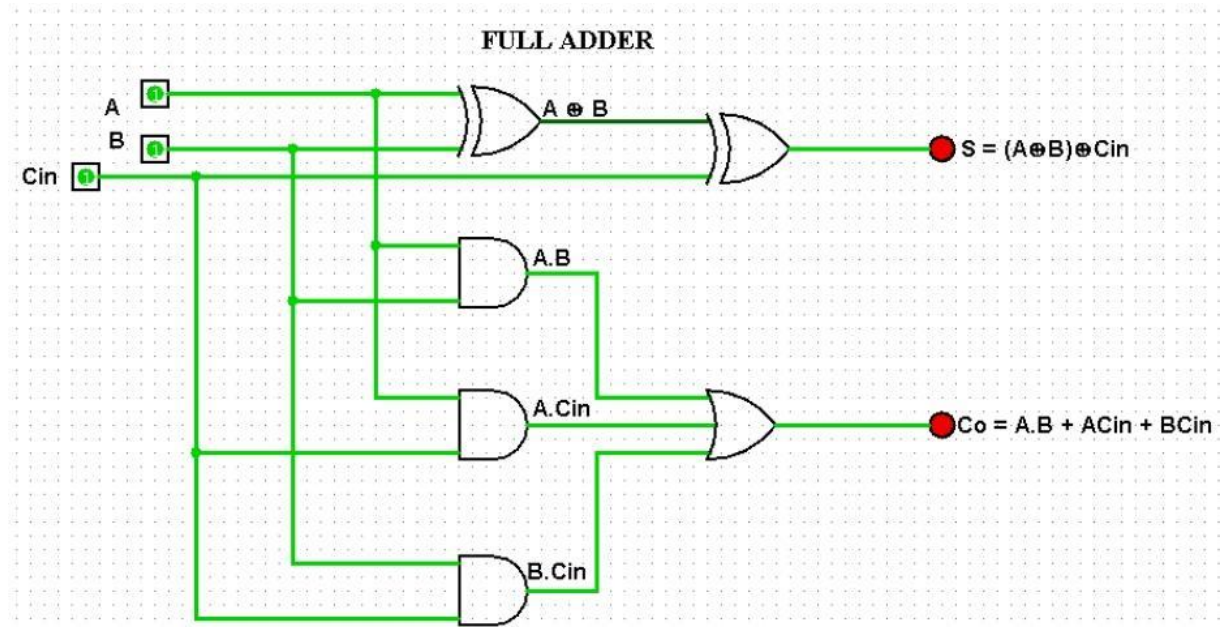
Conclusion: Thus, we realized difference between Half Adder and Full Adder