Digital Logic Design

(EL-1005)

LABORATORY MANUAL

SPRING 2024

LAB 07

Adder and Subtractor

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STUDENT NAME ROLL NO SEC

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FACULTY'S SIGNATURE & DATE

MARKS AWARDED: /02

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Lab Session 07: Adder and Subtractor

OBJECTIVES:

- Distinguish between Half Adder and Full Adder, their functions and logic diagrams.
- Define some useful terminologies like CARRY, SUM, Difference and Borrow

APPARATUS:

- Logic trainer

COMPONENTS:

ICs 74LS02, 74LS00, 74LS08, 74LS32, 74LS04, Jumper Wire

Theory:

In electronics, an adder or summer is a digital circuit that performs addition of numbers.

For single bit adders, there are two general types:

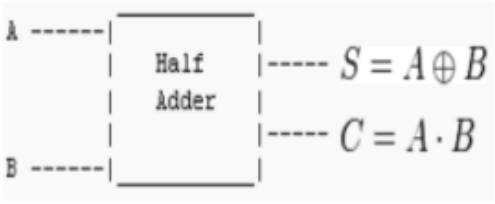
✓ Half Adder

✓ Full Adder

1. Half Adder

A half adder is a logic circuit which performs addition of two binary one-bit inputs and has two binary outputs as a result. The outputs are designated as Sum (S) and Carry (C).

Circuit Diagram



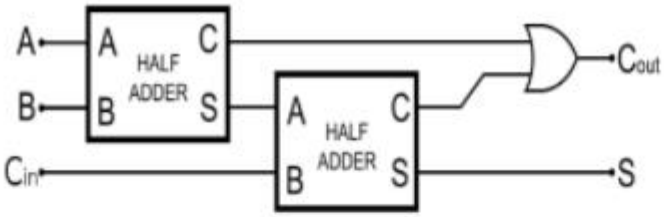
Truth Table:

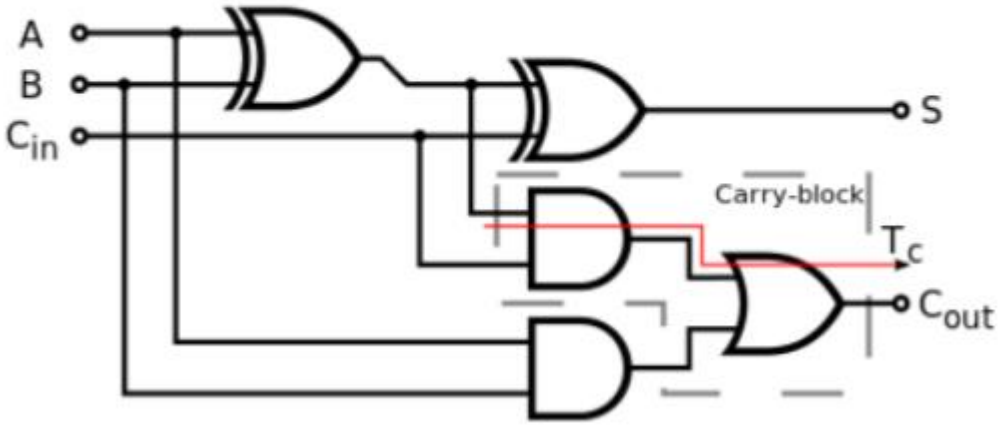
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

2. Full Adder:

The downfall of half adders is that while they can generate a carry out output, they cannot deal with a carry in signal.

A full adder solves this problem by adding three numbers together - the two addends as in the half adder, and a carry in input. The outputs of the full adder are designated as Sum (S) and Carry out (Cout). A block diagram of Full Adder implementation is as follows:





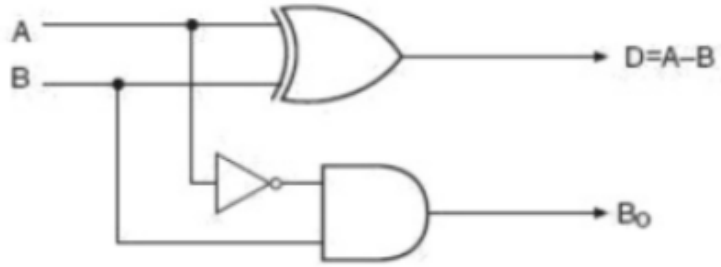
TRUTH TABLE

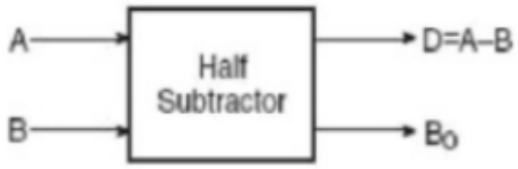
Inputs			Outputs	
A	**B**	**C_{in}**	**Sum**	**Carry**
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

3. Half Subtractor

A half subtractor circuit performs the subtraction of two binary inputs and has two binary outputs as a result. The outputs of the half subtractor are designated as Difference (D) and Borrow (B). The difference and borrow are the binary difference and borrow and has either '0' or '1' logic.

Circuit Diagram:





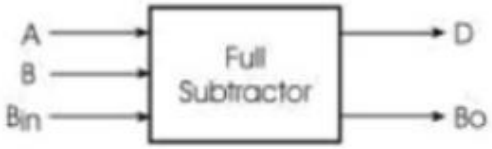
Truth Table:

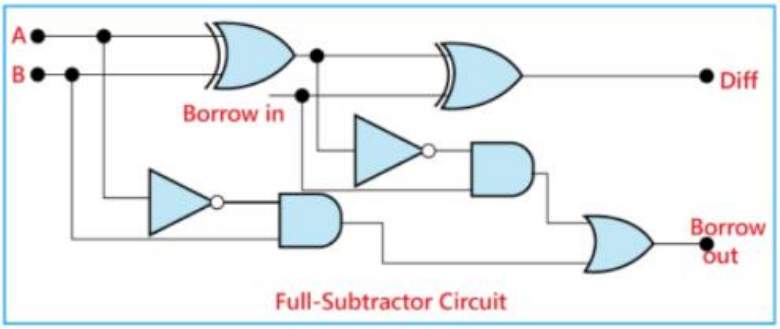
A	B	Difference	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

4. Full Subtractor

Full subtractor is a logic circuit that performs binary subtraction of two 2-bit numbers. It generates two outputs namely "Difference" and "Borrow".

CIRCUIT DIAGRAM





TRUTH TABLE

Minuend (A)	Subtrahend (B)	Borrow In (B_{in})	Difference (D)	Borrow Out (B_O)
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

BOOLEAN EXPRESSIONS

D = A'B'Bin + AB'Bin'+ A'BBin' + ABBin = $\mathbf{A \oplus B \oplus B_{in}}$

Bout = A'Bin + A'B + BBin

LAB TASKS

Name _____ Student ID _____ Section _____

Exercise # 1

Use K-Map to find expression for Carry and Sum for Full Adder. Use Truth Table Given in manual.

Exercise # 2

Design and implement Full Adder Circuit on Bread board.

Exercise # 3

Design and implement Full Subtractor Circuit on Bread board.