EXPERIMENT: 3 ADDERS AND SUBTRACTORS

AIM: To realize

i) Half Adder and Full Adder

ii) Half Subtractor and Full Subtractor by using Basic gates and NAND gates

LEARNING OBJECTIVE:

- To realize the adder and subtractor circuits using basic gates and universal gates
- To realize full adder using two half adders
- To realize a full subtractor using two half subtractors

COMPONENTS REQUIRED:

IC 7400, IC 7408, IC 7486, IC 7432, Patch Cords

THEORY:

Half-Adder: A combinational logic circuit that performs the addition of two data bits, A and B, is called a half-adder. Addition will result in two output bits; one of which is the sum bit, S, and the other is the carry bit, C. The Boolean functions describing the half-adder are:

$S = A \oplus B$ $C = A\ B$

Full-Adder: The half-adder does not take the carry bit from its previous stage into account. This carry bit from its previous stage is called carry-in bit. A combinational logic circuit that adds two data bits, A and B, and a carry-in bit, Cin , is called a full-adder. The Boolean functions describing the full-adder are:

$S = (x \oplus y) \oplus Cin$ $C = xy + Cin\ (x \oplus y)$

Half Subtractor: Subtracting a single-bit binary value B from another A (i.e. A -B) produces a difference bit D and a borrow out bit B-out. This operation is called half subtraction and the circuit to realize it is called a half subtractor. The Boolean functions describing the half-Subtractor are:

$S = A \oplus B$ $C = A'\ B$

Full Subtractor: Subtracting two single-bit binary values, B, Cin from a single-bit value A produces a difference bit D and a borrow out Br bit. This is called full subtraction. The Boolean functions describing the full-subtracter are:

$D = (x \oplus y) \oplus Cin$ $Br = A'B + A'(Cin) + B(Cin)$

I. TO REALIZE HALF ADDER

TRUTH TABLE

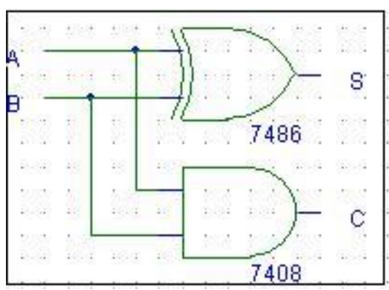
INPUTS		OUTPUTS	
A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

BOOLEAN EXPRESSIONS:

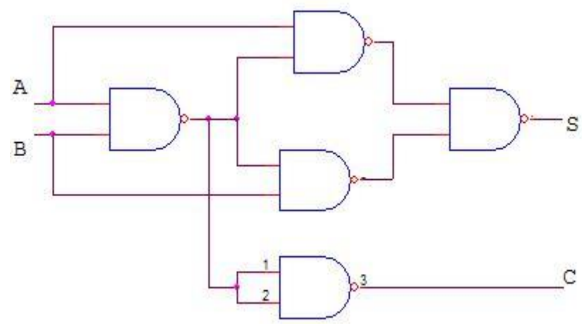
$S=A \oplus B$

$C=A\,B$

i) Basic Gates



ii) NAND Gates



II. FULL ADDER

TRUTH TABLE

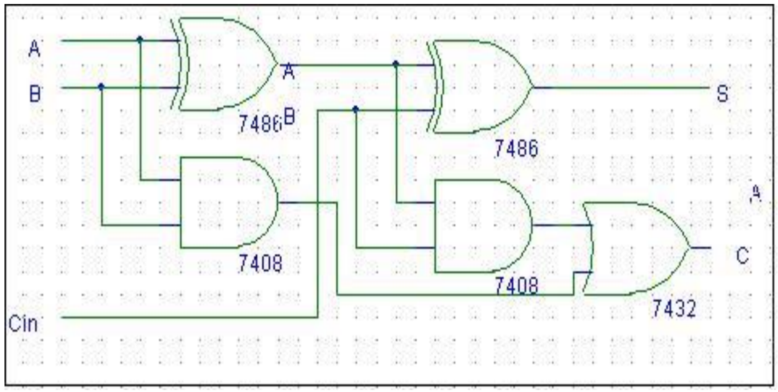
INPUTS			OUTPUTS	
A	B	Cin	S	C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

BOOLEAN EXPRESSIONS:

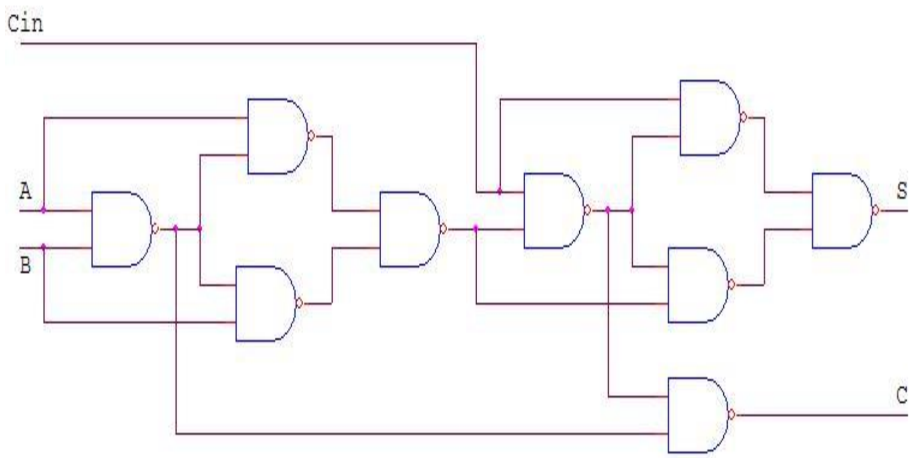
$S= A \oplus B \oplus C$

$C=A\,B + B\,Cin + A\,Cin$

i)BASIC GATES



ii) NAND GATES



III. HALF SUBTRACTOR

TRUTH TABLE

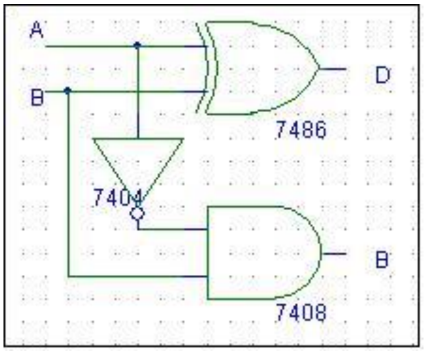
INPUTS		OUTPUTS	
A	B	D	Br
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

BOOLEAN EXPRESSIONS:

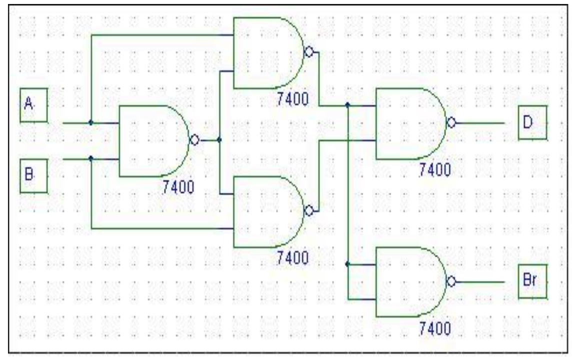
$D = A \oplus B$

$Br = \bar{A}B$

i)BASIC GATES



ii) NAND Gates



IV. FULL SUBTRACTOR

TRUTH TABLE

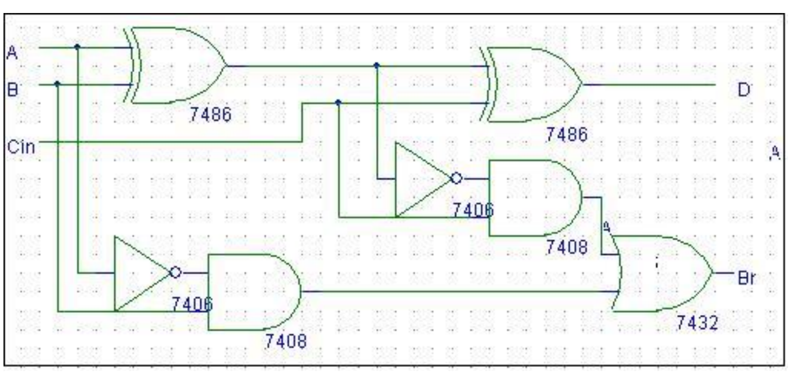
INPUTS			OUTPUTS	
A	B	Cin	D	Br
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

BOOLEAN EXPRESSIONS:

$D = A \oplus B \oplus C$

$Br = \bar{A} B + B\, Cin + \bar{A}\, Cin$

i) BASIC GATES



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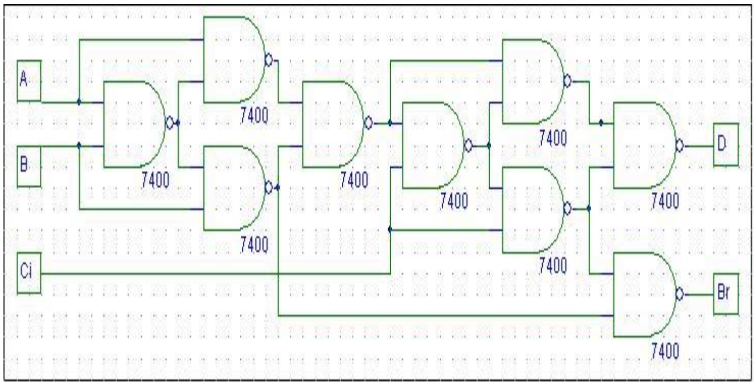
ii) To Realize the Full subtractor using NAND Gates only



PROCEDURE:

1. Check the components for their working.
2. Insert the appropriate IC into the IC base.
3. Make connections as shown in the circuit diagram.
4. Verify the Truth Table and observe the outputs.