YASH GUPTA

S20200010234

LAB - 2

Experiment - 2

DATE:- 24/12/2020

Q-1

AIM:- To build NOR gate using NAND

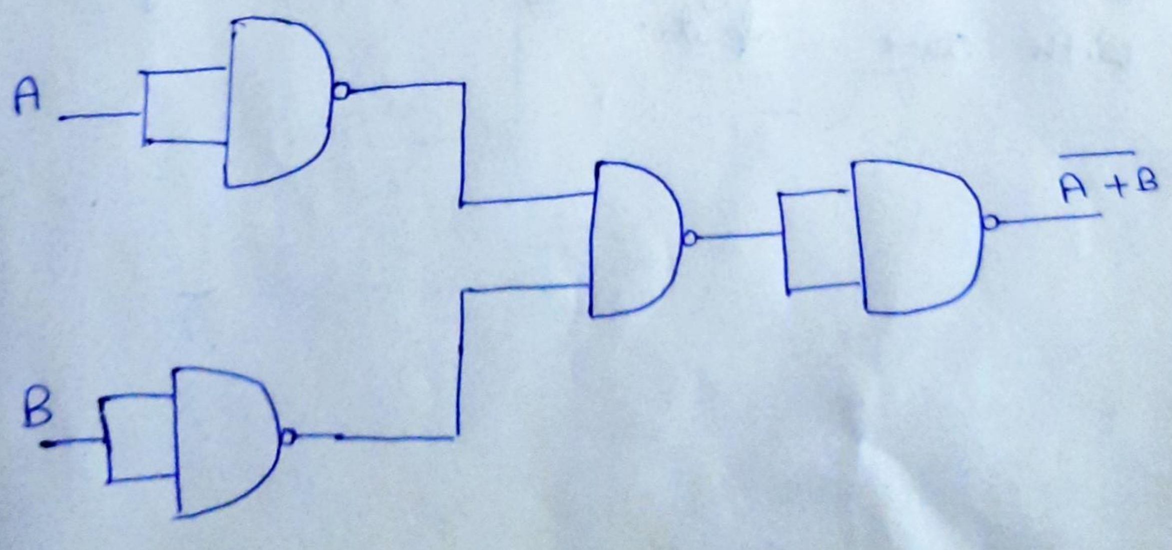
Requirements:- Logism Software

TRUTH TABLE:-

Input		Output
A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

Boolean Expression:- $\boxed{Y = \overline{A+B}}$ — ①

Logic Circuits:-



CHECKING THE CIRCUIT

Case (i) If A="0", B="0", then Y = 1,

Substitute in Eq ①

$$Y = \overline{A+B}$$

$$Y = \overline{0+0}$$

$$Y = \overline{0}$$

$$Y = 1$$, Satisfied

Case (ii) If A="1", B="0", then Y = 0.

Substitute in Eq ①

$$Y = \overline{A+B}$$

$$Y = \overline{0+1}$$

$$Y = \overline{1}$$

$$Y = 0$$, Satisfied

Conclusion: The NOR gate using NAND gate is simulated using logism and verified with some inputs.

Q-2

AIM:- To build XOR gate using NAND

Requirements:- Logism Software

TRUTH TABLE:-

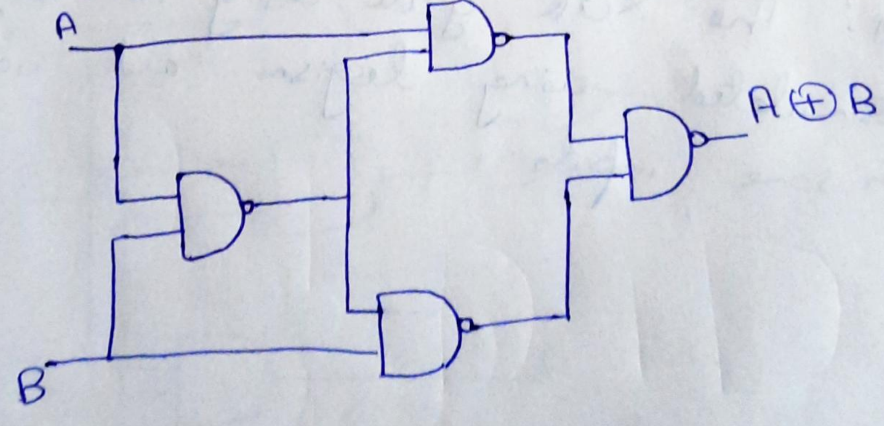
Input		Output
A	B	C
0	0	0
1	0	1
0	1	1
1	1	0

Boolean Expression:- $\boxed{C = A \oplus B}$

Or

$\boxed{C = A\bar{B} + \bar{B}A}$ - Eq ①

Logical Circuits:-



CHECKING THE CIRCUIT

Case (i) If A = "0", B = "0", then C = "0".

Substitute in Eq (1)

$$C = A\bar{B} + B\bar{A}$$
$$C = 0\bar{0} + 0\bar{0}$$
$$C = 0 \cdot 1 + 0 \cdot 1$$
$$C = 0$$, Satisfied

Case (ii) If A = "1", B = "0", then C = "1",

Substitute in Eq (1)

$$C = A\bar{B} + B\bar{A}$$
$$C = 1\bar{0} + 0\bar{1}$$
$$C = 1 \cdot 1 + 0 \cdot 0$$
$$C = 1$$, Satisfied

Conclusion: The XOR gate using NAND gate is simulated using logism and verified with some inputs.

Q-3

AIM:- To build Half adder

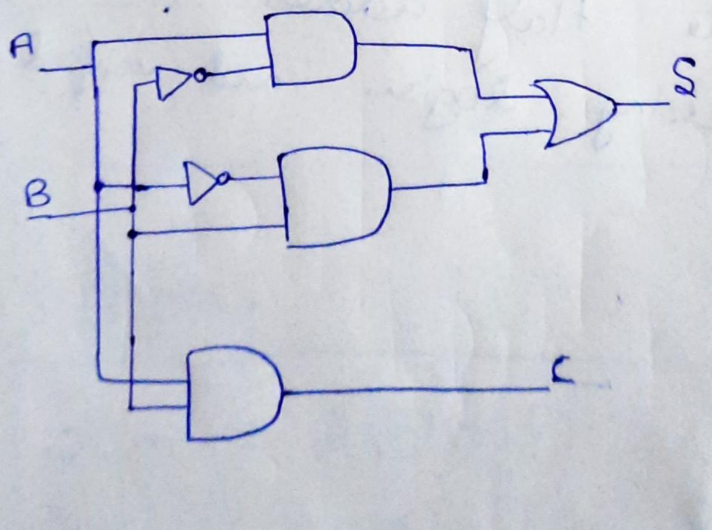
Requirements:- Logism Software

TRUTH TABLE:-

Inputs		Outputs	
A	B	S	C
0	0	0	0
1	0	1	0
0	1	1	0
1	1	0	1

Boolean Expression:- $S = A \oplus B$
$C = AB$

Logical Circuits:



CHECKING THE CIRCUIT

Case(i) If $A = "1"$, $B = "0"$, then $S = "1"$, $C = "0"$

Substitute in eq

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

$S = 1\bar{0} + 0\bar{1}$

$S = 1 \cdot 1 + 0 \cdot 0$

$S = 1$, Satisfied

$C = AB$

$C = 1 \cdot 0$

$= 0$, Satisfied

Case (ii) If $A = "1"$, $B = "1"$, then $S = "0"$, $C = "1"$

Substitute in eq

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

$S = 1\bar{1} + 1\bar{1}$

$S = 0 + 0$

$S = 0$, Satisfied

$C = A \cdot B$

$= 1 \cdot 1$

$= 1$, Satisfied

Conclusion: The Half adder circuit is simulated using logism and verified with some inputs.

Q-4

AIM: To build Full Adder

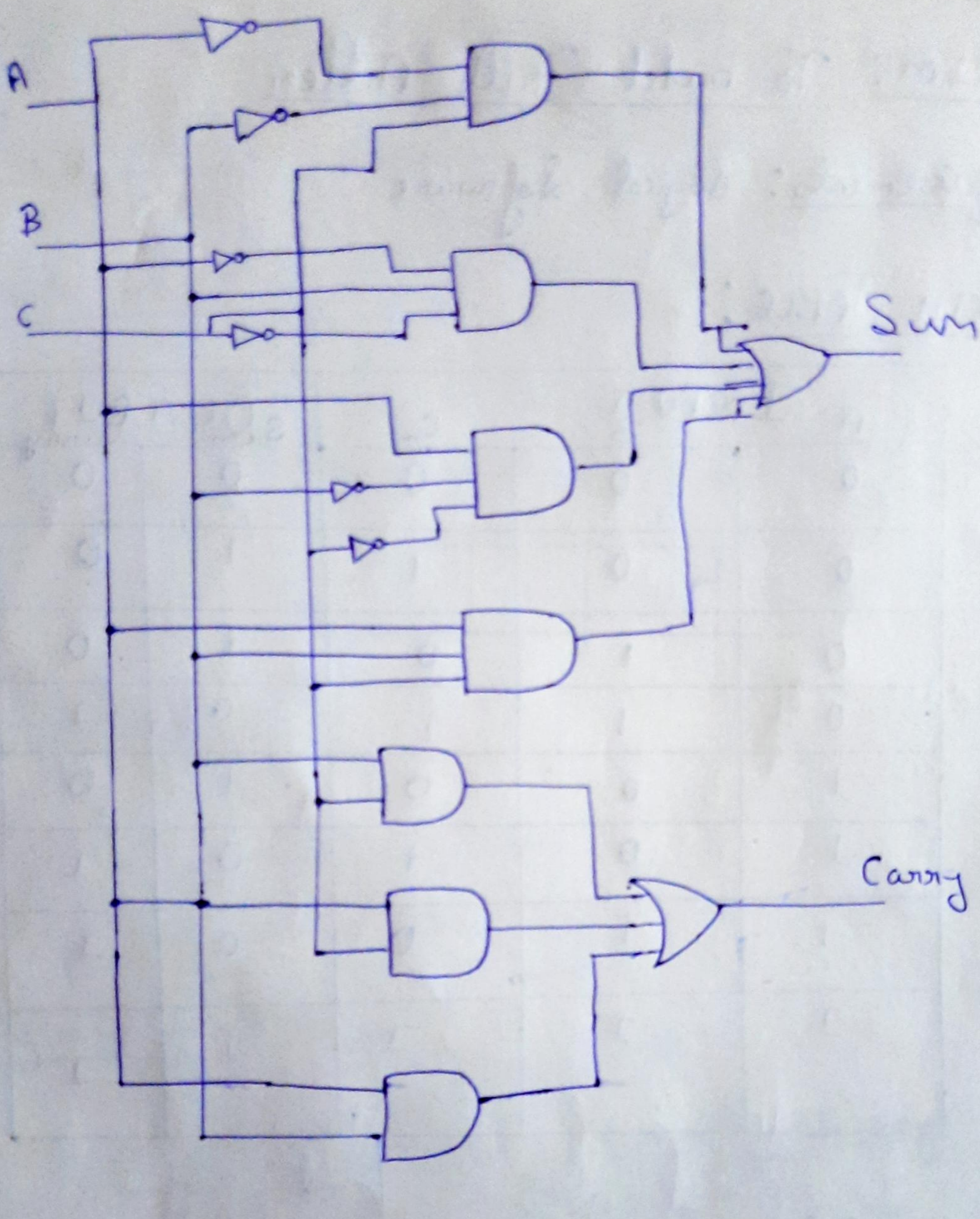
Requirements: Logical Software

TRUTH TABLE:

INPUT			OUTPUT	
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

Boolean Expression:

$$\boxed{\begin{aligned} Sum &= A \oplus B \oplus C_{in} \\ Carry &= AB + (A \oplus B) C_{in} \end{aligned}}$$


A
B
C
Sum
Carry

CHECKING THE CIRCUIT

Case (i) If $A = "0"$, $B = "0"$, $C_{in} = "1"$, then

$Sum = "1"$, $Carry = "0"$

Substituting in eqⁿ

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

$$= \bar{0}\cdot\bar{0}\cdot 1 + \bar{0}\cdot 0\cdot \bar{1} + 0\cdot 0\cdot \bar{1} + 0\cdot 0\cdot 1$$

$$= 1\cdot 1\cdot 1 + 0 + 0 + 0$$

$$= 1 \text{, Satisfied}$$

$$Carry = AB + BC_{in} + C_{in}A$$

$$= 0\cdot 0 + 0\cdot 1 + 1\cdot 0$$

$$= 0 \text{, Satisfied}$$

Case (ii) If $A = "1"$, $B = "1"$, $C_{in} = "0"$, then

$Sum = 0$, $Carry = 1$

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

$$= \bar{1}\bar{1}\cdot 0 + 1\cdot\bar{1}\cdot\bar{0} + \bar{1}\cdot 1\cdot\bar{0} + 1\cdot 1\cdot 0$$

$$= 0 + 0 + 0 + 0$$

$$= 0 \text{, Satisfied}$$

$$Carry = AB + BC_{in} + C_{in}A$$

$$= 1\cdot 1 + 1\cdot 0 + 0\cdot 1$$

$$= 1 \text{, Satisfied}$$

Conclusion: The full adder circuit is simulated using logism and verified with some inputs.

Q.5

AIM: To build Half Subtractor

Requirements: Logical Software

Truth Table:

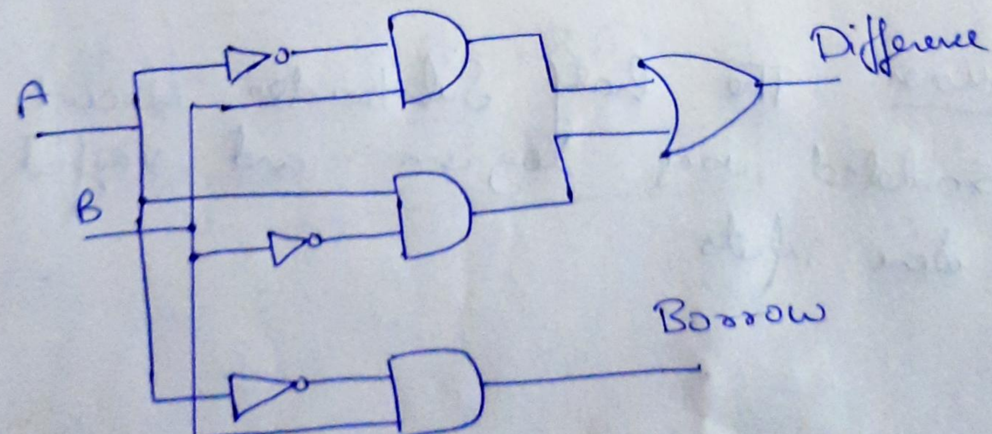
Input		Output	
A	B	Difference	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Boolean Expression:

Difference $= A \oplus B$

Borrow $= \bar{A}B$

Logical Circuit:



CHECKING THE CIRCUIT

Case (i) If A = "0", B = "1", then difference = "1",
& Borrow = "1"

Substitute in eqⁿ

Difference = $A\bar{B} + B\bar{A}$
$= 0\bar{1} + 1\bar{0}$
$= 0 0 + 1 \cdot 1$
$= 1$

Borrow = $\bar{A}B$
$= \bar{0} 1$
$= 1 \cdot 1$
$= 1$

Case (ii) If A = "1", B = "1", then difference = "0"
Borrow = "0"

Substitute in eqⁿ

* Difference = $A\bar{B} + B\bar{A}$
$= 1 \cdot \bar{1} + 1 \cdot \bar{1}$
$= 0 + 0$
$= 0$

Borrow = $\bar{1} \cdot 1$
$= 0 \cdot 1$
$= 0$

Conclusion: The half Subtractor circuit is simulated using logism and verified with some inputs.

Q-6

AIM : To build full Subtractor

Requirements : Logical Software

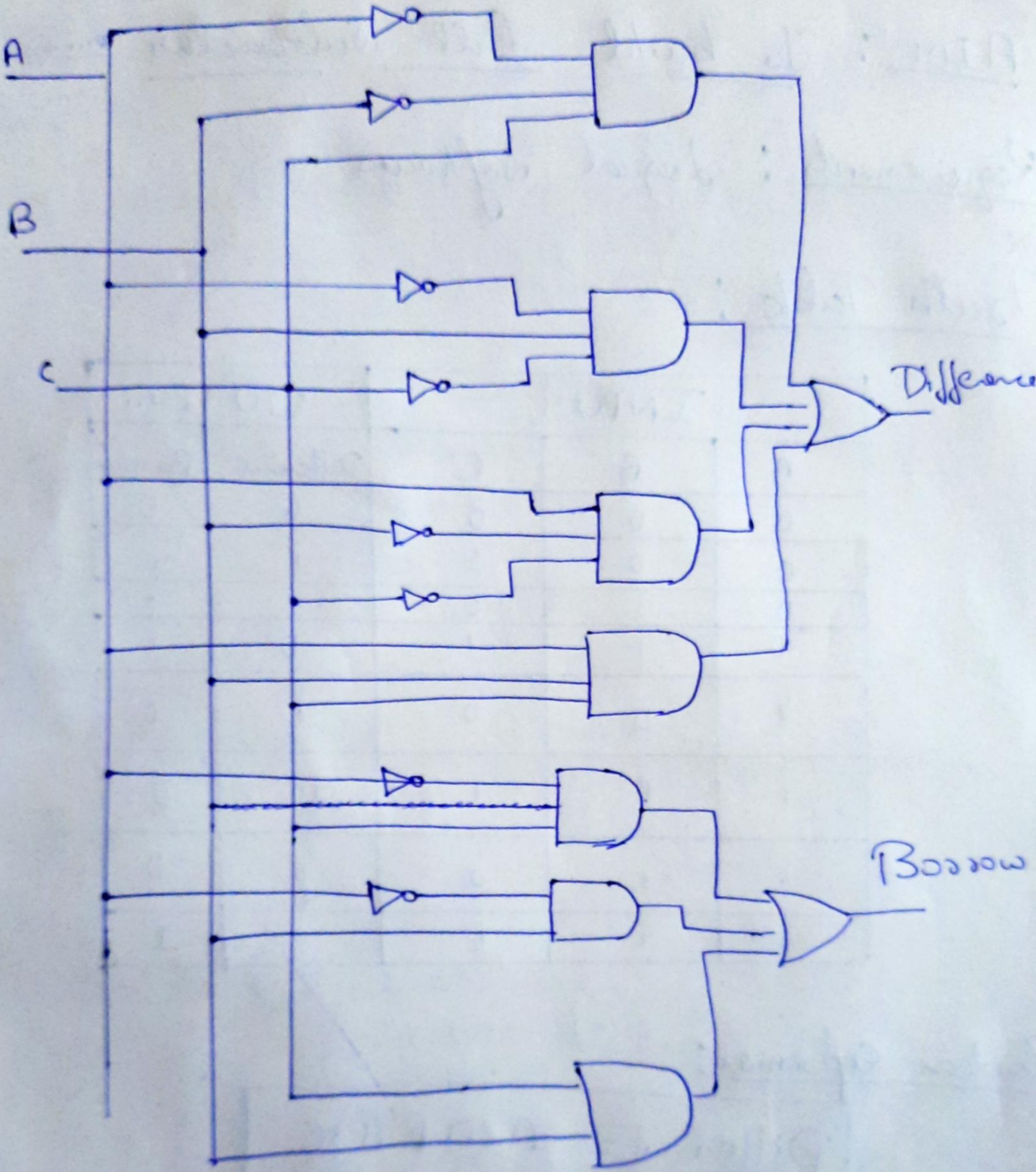
Truth Table :

INPUT			OUTPUT	
A	B	C	Difference	Borrow
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 Expression:

Difference = $A \oplus B \oplus C$

Borrow = $\bar{A}C + \bar{A}B + BC$


A
B
C
Difference
Borrow

CHECKING THE CIRCUIT

Case (i) If $A = "0"$, $B = "0"$, $C = 1$, then
Difference $= 1$, Borrow $= 1$
Substituting in Eqⁿ

Difference $= A\bar{B}\bar{C} + B\bar{A}\bar{C} + C\bar{A}\bar{B} + ABC$
$= 0.\bar{0}.\bar{1} + 0.\bar{0}.\bar{1} + 1.\bar{0}.\bar{0} + 0.0.1$
$= 0 + 0 + 1 + 0$
$= 1$, Satified

Borrow $= \bar{A}C + \bar{A}B + BC$
$= \bar{0}1 + \bar{0}.0 + 0.1$
$= 1 + 0 + 0$
$= 1$, Satisfied

Case (ii) If $A = "1"$, $B = "1"$, $C = "0"$, then ~~C = 0~~
Difference $= "0"$, Borrow $= "0"$

Difference $= A\bar{B}\bar{C} + B\bar{A}\bar{C} + C\bar{A}B + ABC$
$= 1.\bar{1}.\bar{0} + 1.\bar{1}.\bar{0} + 0.\bar{1}.\bar{1} + 1.1.0$
$= 0 + 0 + 0 + 0$
$= 0$

Borrow $= \bar{A}\cancel{C} + \bar{A}B + BC$
$= \bar{1}.0 + \bar{1}.1 + 1.0$
$= 0 + 0 + 0$
$= 0$

Conclusion: The full subtractor circuit is simulated using logism and verified with some inputs.