INDRAPRASTHA INSTITUTE *of*
INFORMATION TECHNOLOGY
DELHI

Department
of
Electronics & Communication Engineering

ECE111|Digital Circuits

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Lab_2:

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Date: 28/01/2021

Part A

Aim: Prove De-Morgan's Theorem

1. (A+B)'=A'.B'
2. (A.B)'=A'+B'

Components/ICs: Breadboard, Red LED, 1 kΩ Resistor, [5,5 Power Supply], Wire, slideswitch,

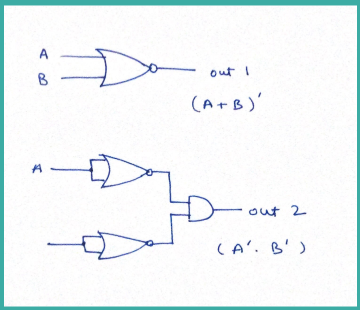
1.Quad AND gate(74HC08), Quad NOR gate(74HC02)

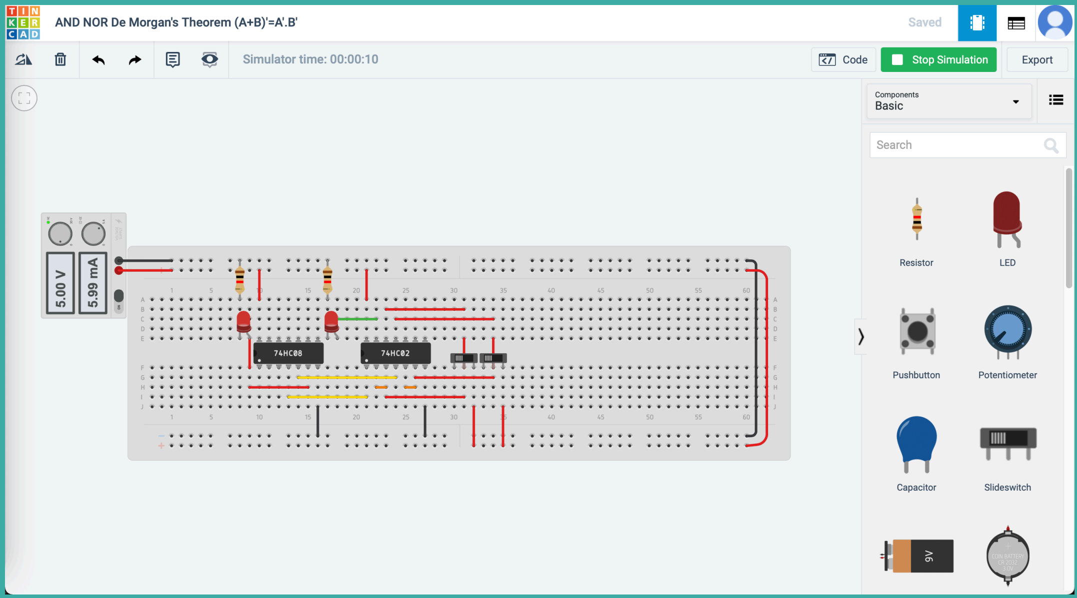
2.Quad OR gate(74HC32), Quad NAND gate(74HC00)

Link of TINKERCAD Workspace: 1. https://www.tinkercad.com/things/iAi0n9GpUik

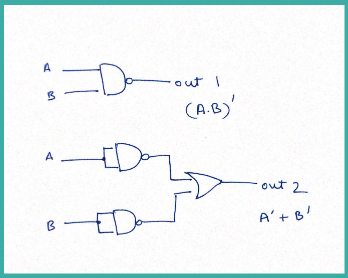
2. https://www.tinkercad.com/things/4ikOMLh9b7c

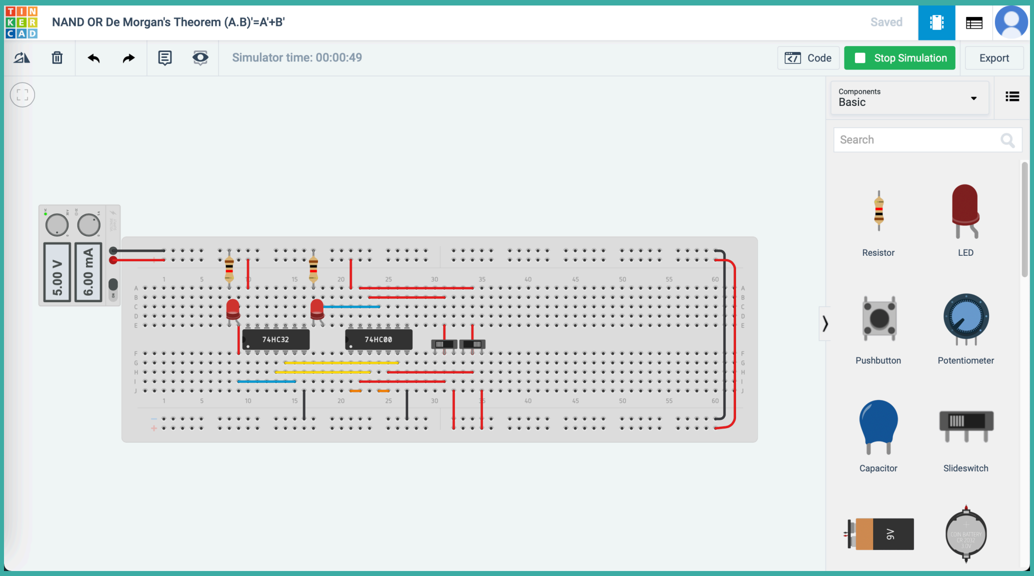
Circuit Diagram:





Part A(1)





Part A(2)

Truth Table:

A	B	A’	B’	A+B	A.B	(A+B)’	A’.B’	(A.B)’	A’+B’
0	0	1	1	0	0	1	1	1	1
0	1	1	1	1	0	0	0	1	1
1	0	0	0	1	0	0	0	1	1
1	1	0	0	1	1	0	0	0	0

Observations/Results: This proves the De-Morgan’s Theorem

Applications of the experiment: **DeMorgan's Theorem** is useful in the **implementation** of the basic gate operations with alternative gates, particularly with NAND and NOR gates which are readily available in IC form.

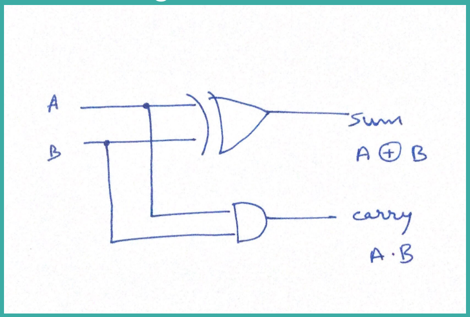
Part B

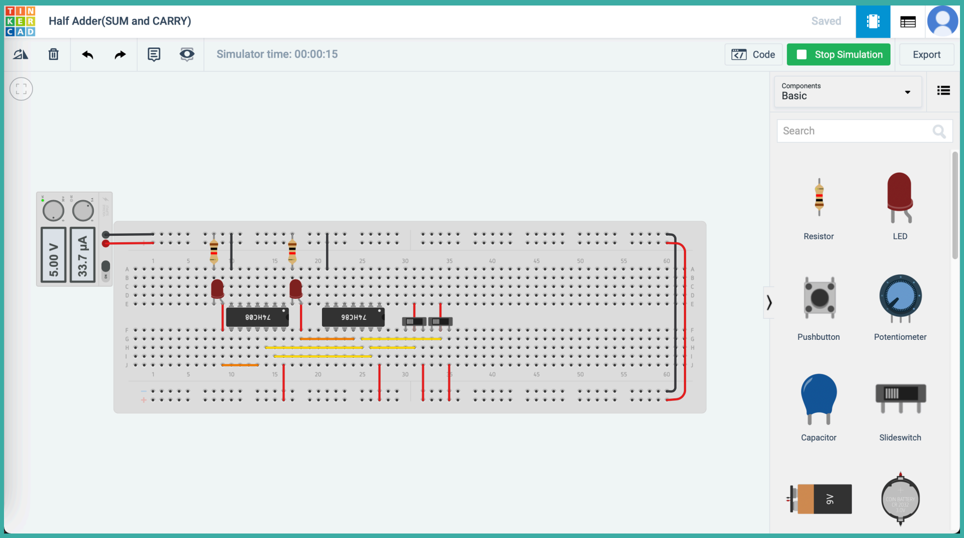
Aim: Implement Binary Half Adder using Gates

Components/ICs: Breadboard, Red LED, 1 kΩ Resistor, [5,5 Power Supply], Wire, slideswitch, Quad AND gate(74HC08), Quad NOR gate(74HC02)

Link of TINKERCAD Workspace: https://www.tinkercad.com/things/kyr5rJD3e2f

Circuit Diagram:





Truth Table:

A	B	SUM	CARRY
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Observations/Results: The half adder satisfies the Truth table.

Applications of the experiment: 1. The ALU (arithmetic logic circuitry) of a computer uses half adder to compute the binary addition operation on two bits.
2. Half adder is used to make full adder as a full adder requires 3 inputs, the third input being an input carry i.e. we will be able to cascade the carry bit from one adder to the other.

3. Ripple carry adder is possible to create a logical circuit using multiple full adders to add N-bit numbers. Each full adder inputs a C(in), which is the C(out) of the previous adder. This kind of adder is called RIPPLE CARRY ADDER, since each carry bit "ripples" to the next full adder. Note that the first full adder (and only the first) may be replaced by a half adder.

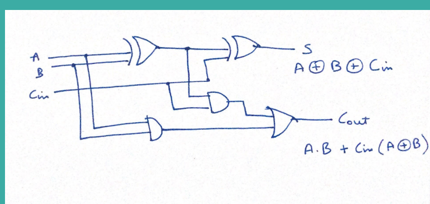
Part C

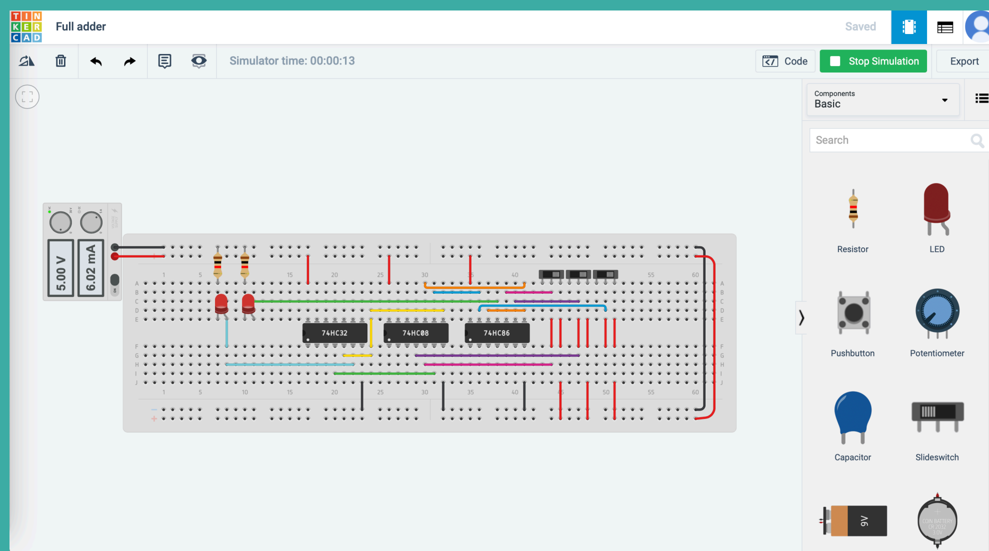
Aim: Implement Binary Full Adder using Gates

Components/ICs: Breadboard, Red LED, 1 kΩ Resistor, [5,5 Power Supply], Wire, slideswitch, Quad AND gate(74HC08), Quad NOR gate(74HC02)

Link of TINKERCAD Workspace: https://www.tinkercad.com/things/1jUJELoH3nt

Circuit Diagram:





Truth Table:

C-in	B	A	SUM	C-out
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

Observations/Results: The Binary Full Adder satisfies the Truth table.

Applications of the experiment : 1. A Full Adder's circuit can be used as a part of many other larger circuits like Ripple Carry Adder, which adds n-bits simultaneously.
2. The dedicated multiplication circuit uses Full Adder's circuit to perform Carryout Multiplication.
3. Full Adders are used in ALU- Arithmetic Logic Unit.

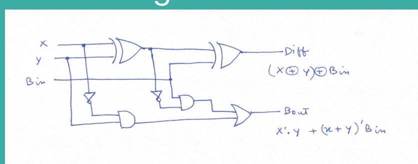
Part D

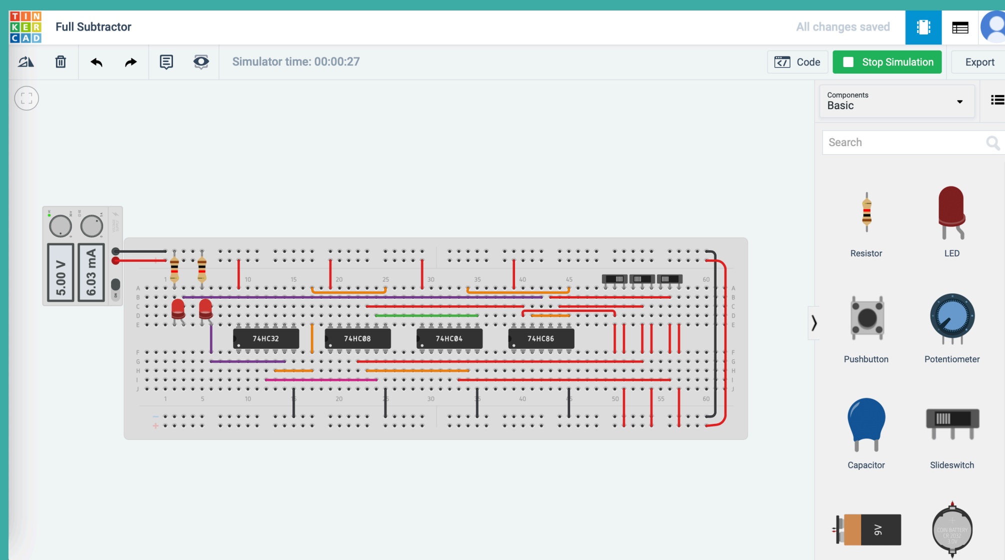
Aim: Implement Binary Full Subtractor using Gates

Components/ICs: Breadboard, Red LED, $1\ \mathrm{k}\Omega$ Resistor, [5,5 Power Supply], Wire, slideswitch, Quad AND gate(74HC08), Quad NOR gate(74HC02)

Link of TINKERCAD Workspace: https://www.tinkercad.com/things/0IKpgwFyUZG

Circuit Diagram:





Truth Table:

B-in	Y	X	Diff.	B-out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	1
0	1	1	0	0
1	0	0	1	1
1	0	1	0	0
1	1	0	0	1
1	1	1	1	1

Observations/Results: The Binary Full Subtractor satisfies the Truth table.

Applications of the experiment: 1.Full Subtractor is a combinational logic circuit.
2. It is used for the purpose of subtracting two single bit numbers.
3. It also takes into consideration borrow of the lower significant stage.
4. Thus, full subtractor has the ability to perform the subtraction of three bits.
5. Full subtractor contains 3 inputs and 2 outputs (Difference and Borrow)