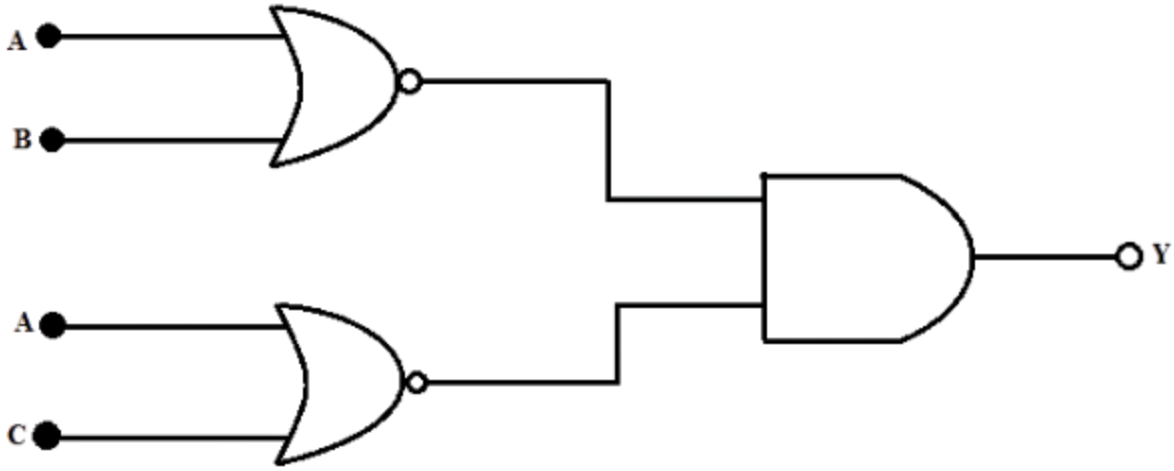
Faith Academy

Senior Secondary School

Physics Investigatory Project

2022-2023

Logic Gate



Roll No. 26602373

Certificate

This is to certify that Aman Kushwaha, a student of class XII C has successfully completed the project on the project "Logical Gate" under the guidance of Vice-Principal, Mrs. Arputhalatha Angels during partial fulfillment of Physics Practical Examinations conducted by C.B.S.E. (Central Board of Secondary Education), New Delhi.

Signature

Vice Principal

Acknowledgment

I have made efforts in this project. However, it would not have been possible without the kind support and help of many individuals.

I would like to thank my Principal, Dr. M. Kannan, Vice Principal, Mrs. Arputhalatha Angels, and the school for providing me with the facilities required to do my project.

I am highly indebted to my Physics teacher, Mrs. R Angel Jeneafer, for her invaluable guidance which has sustained my efforts in all the stages of this project.

I would also like to thank my parents for their continuous support and encouragement.

My thanks and appreciation also go to my fellow classmates and the laboratory assistant in developing the project and to the people who have willingly helped me out with their abilities.

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Introduction

Gate: A gate is defined as a digital circuit that follows some logical relationship between the input and output voltages. It is a digital circuit that either allows a signal to pass through or stops it.

The logic gates are building blocks of digital electronics. They are used in digital electronics to change one voltage level into another according to some logic statement relating to them.

Trust Table: A logic gate may have one or more than one input, but it has only one output. The relationship between the possible values of input and output voltages is expressed in the form of a table called the Truth table.

The Truth table of a logic gate is a table that shows all The inputs and outputs that are possible for the logic gates.

Boolean algebra: The algebra which is based on the binary nature of the logic gates.

Boolean Expressions: - They are the logical statement that is followed by logical gates.

Principle

Any Boolean algebraic operation can be associated with the input and output, which represents the statement of Boolean algebra. Although these circuits may be complex, they may all be constructed from three basic Devices like a P-N junction diode, a resistance, and an N-P- N transistor.

We have three different types of logic gates and they are the AND gate, the OR gate, and the NOT gate.

Logical Statements

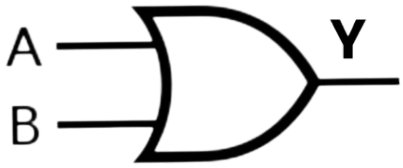
1	0
High	Low
Positive	Negative
On	Off
Close	Open
Conducting	Non-Conducting
Right	Wrong
True	False
Yes	No

Basic Gates

The OR Gate: - It is a device that combines A and B to give Y as the result. The OR gate has two or more inputs and one output. In Boolean algebra, the addition symbol (+), is referred to as the OR.

The Boolean expression: A+B-Y

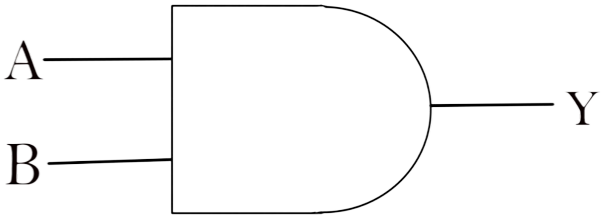
This indicates that Y is equal to A or B.



The AND Gate: It is a device that combines A with B to give Y as the result. The AND gate has two or more inputs and one output. In Boolean algebra, the multiplication sign is referred to as the AND.

The Boolean expression: A.B=Y or A x B=Y

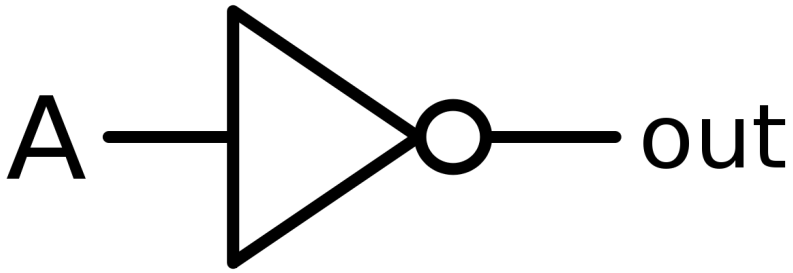
This indicates that Y is equal to A and B.



The NOT Gate: It is a device that inverts the inputs. The NOT has one input and ‘one output. In Boolean algebra, bar symbol is referred as the NOT.

The Boolean expression: $Y=A^{-}$

This indicates that Y is not equal to A.



Experiments

The OR Gate

Aim:

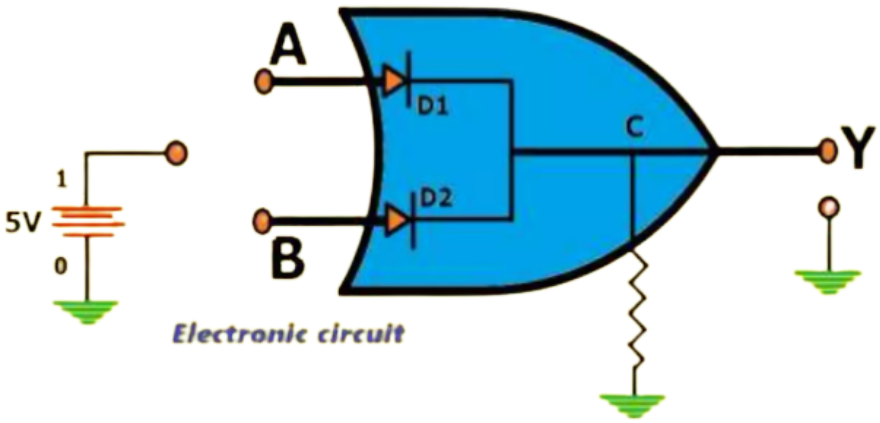
To design and stimulate the OR gate circuit.

Components:

Two ideal p-n junction diodes (D1 and D2).

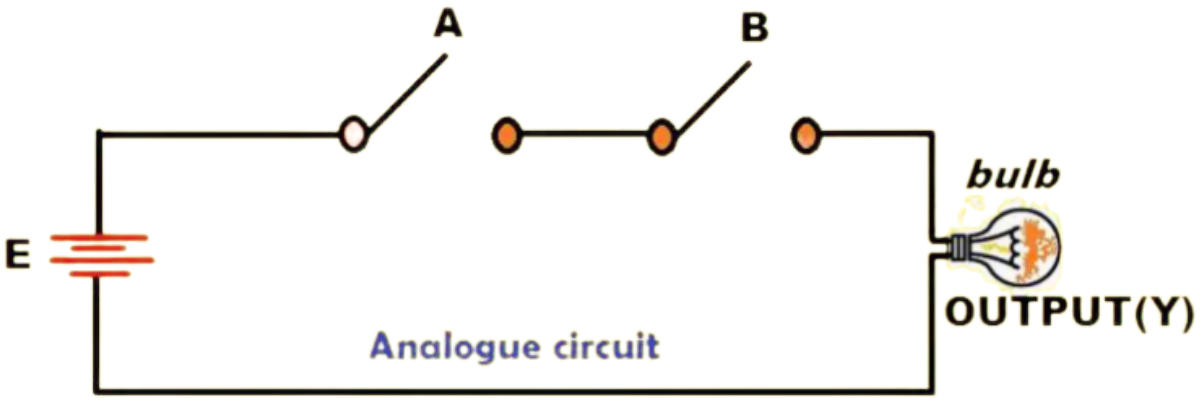
Theory and Construction:

An OR gate can be realized by the electronic circuit, making use of two diodes D1 and D2.



Hear the negative terminal of the battery is grounded and corresponds to the 0 level, and the positive terminal of the battery corresponds to level

1. The output Y is the voltage at C with respect to the earth.



The following conclusion can be drawn from the above circuit:

I. If the switches A and B are kept open (A = 1, B = 0), then the bulb does not glow, hence Y = 0
II. If switch A is kept closed and B is kept open (A = 1, B = 0), then the bulb does not glow, hence Y = 0
III. If switch A is kept open and B is kept closed (A = 0, B = 1), then the bulb does not glow, hence Y=0
IV. If the switches A and B both are kept closed (A = 1, B = 1), then the bulb glows, hence Y = 1

Truth Table:

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

The AND Gate

Aim:

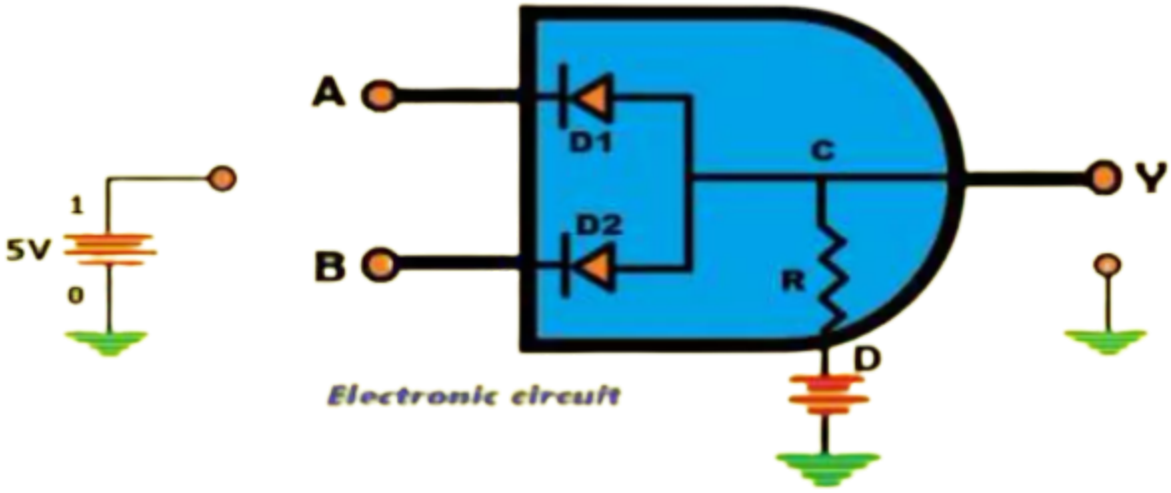
TO DESIGN AND STIMULATE THE AND GATE CIRCUIT.

Components:

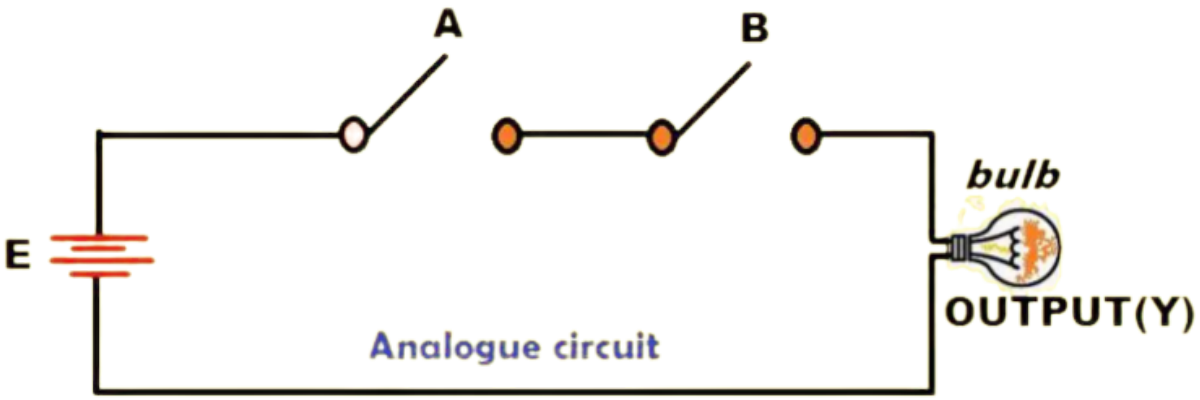
Two ideal p-n junction diodes (D1 and D2) and resistance R.

Theory and Construction:

An AND gate can be realized by the electronic circuit, making use of two diodes D1 and D2. The resistance R is connected to the positive terminal of a 5V battery permanently.



Here the negative terminal of the battery is grounded and corresponds to the 0 level, and the positive terminal of the battery corresponds to the level 1. The output Y is the voltage at C with respect to the earth.



The following conclusion can be easily drawn from the working of this circuit:

I. If switches A and B are kept open (A=0, B=0), then the bulb does not glow, hence Y=0.
II. If switch A is kept closed and B is kept open (A=1, B=0), then the bulb does not glow, hence Y=0.
III. If switch A is kept open and B is kept closed (A=0, B=1), then the bulb does not glow, hence Y=0.
IV. If both switches A and B are kept closed (A=1, B-1), then the bulb glows, hence Y=1.

Truth Table:

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

The NOT Gate

Aim:

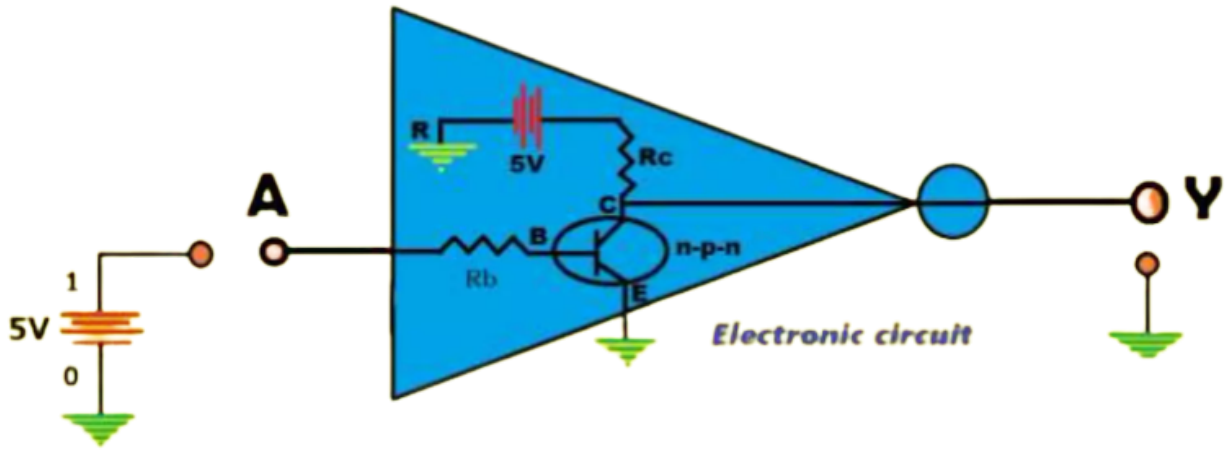
TO DESIGN AND STIMULATE THE NOT GATE CIRCUIT.

Components:

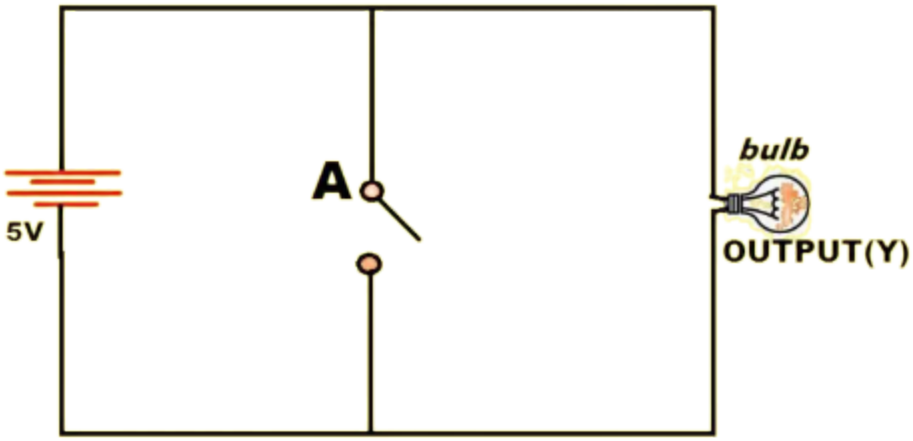
An ideal n-p-n transistor.

Theory and Construction:

A NOT gate cannot be realized by using diodes. However, an electronic circuit of NOT gate can be realized by making use a n-p-n transistor.



The base of the transistor is connected to the input A through a resistance Rb and the emitter is earthed. The collector is connected to a 5V battery. The output Y is the voltage at C with respect to the earth.



The following inference can be easily drawn from the working of the circuit:

I. If switch A is kept open (A=0) then the bulb glows, hence Y=1
II. If switch A is kept closed (A-1) then the bulb does not glow, hence Y=0

Truth Table:

Input	Output
0	1
1	0

The NAND Gate

Aim:

TO DESIGN AND STIMULATE THE NAND GATE CIRCUIT.

Components:

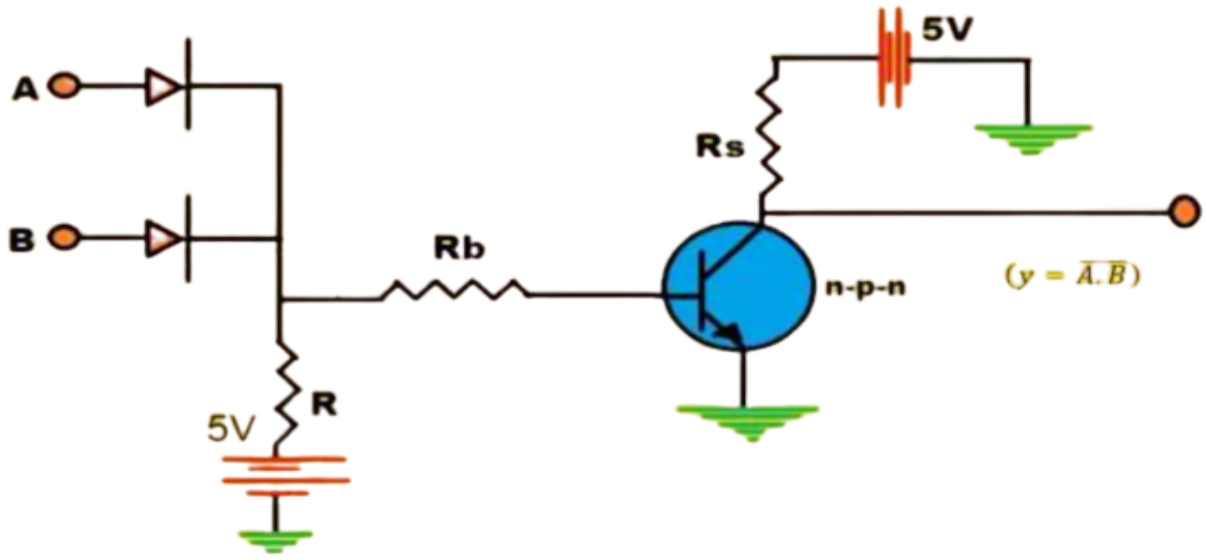
Two ideal p-n junction diode (D1 and D2)

A resistance R

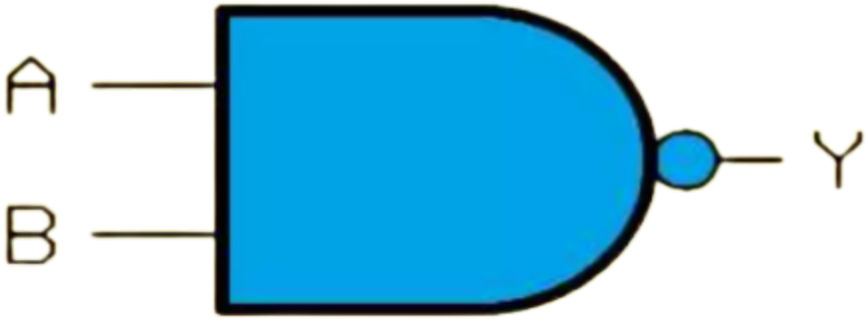
An ideal n-p-n transistor

Theory and Construction:

If we connect the output Y' of the AND gate to the input of a NOT gate then the gate obtained is the NAND gate. The output Y is voltage at C with respect to earth.



In Boolean expression, the NAND gate is expressed as:



The following inference can be easily drawn from the working of the circuit:

I. If switches A and B are kept closed (A = 0, B = 0) then the bulb glows, hence Y = 1 .
II. If switch A is kept open and B is kept closed (A = 0, B = 1), then the bulb glows, hence Y = 1
III. If switch A is kept closed and B is kept open (A = 1, B = 0), then the bulb glows, hence Y = 1
IV. If both switches A and B are kept closed (A = 1, B = 1) then the bulb does not glow, hence Y = 0

Truth Table:

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

Conclusion

In conclusion, logic gates are a fundamental concept in the field of digital electronics and computer science. They are used to perform logical operations on one or more inputs, resulting in a single output.

Logic gates are the building blocks of digital circuits and computers, and they can be combined to create more complex circuits and systems. The most basic logic gates include AND, OR, NOT, NAND, NOR, and XOR, each with its own unique properties and functionality.

Understanding the basic principles and operation of logic gates is crucial for anyone interested in the field of computer science, electrical engineering and related fields. Additionally, the study of logic gates is essential for the design and implementation of digital systems, including computers, mobile phones, and other electronic devices that are ubiquitous in modern society.

Furthermore, the development of new technologies such as quantum computing and artificial intelligence also relies heavily on the principles of logic gates.

Therefore, the study of logic gates will continue to be an important area of research and development in the future.

Bibliography

- https://en.wikipedia.org/wiki/Logic_gate
- https://www.techtarget.com/whatis/definition/logic-gate-AND-OR-XOR-NOT-NAND-NOR-and-XNOR
- Physics NCERT Textbook
- https://www.google.com/search?q=logic+gates