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اسم المادة	تقنيات رقمية
عنوان المحاضرة	**Logic Gate**
رقم المحاضرة	**3**
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AL-Mustaqbal university college

Class: 2nd

Subject: Digital Techniques

Lecturer: Rami Qays Malik

Lecture :3rd – Logic Gate

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LOGIC GATE

INTRODUCTION:

Logic gates are "elementary bricks" used in the construction of digital circuits. While the binary numeration system studied in the precedent lecture was an interesting mathematical abstraction, we have not yet seen its practical application to electronics. This lecture is devoted to practically apply the concept of binary digits to circuits. A logic gate is a special type of circuit designed to accept (inputs) and generate (outputs) voltages signals corresponding to binary digits (1 and 0).

DIGITAL SIGNALS AND GATES:

Let us consider the following circuit:

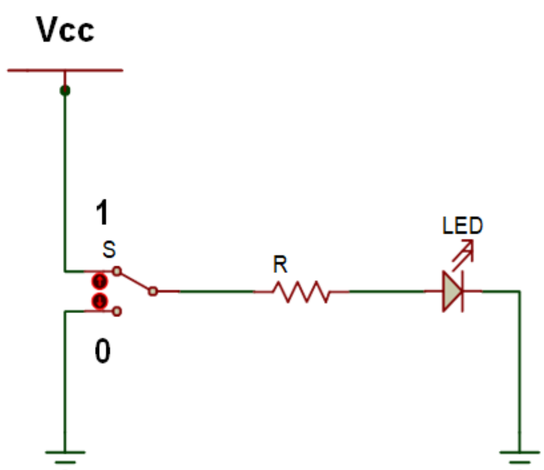

Fig1: logic circuit

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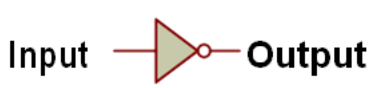
When the switch is connected to the ground (0V), the light emitting diode (LED) does not shine. We would say that the input signal is a binary "0" and that the output is a binary "0". Moving the switch to the other position (Vcc), we apply a binary "1" to the input and receive a binary "1" at the output.

The gate shown by this simple circuit is a "buffer" or "yes" gate, because the logic state of its input is identical to that of its output. Many types of gates are used in digital electronics: single input gates like the buffer and the NOT gates; multiple inputs gates like AND, NAND, OR, NOR, and XOR gates.

1. THE NOT GATE:

The NOT gate or Inverter is a logic gate which functions in such a way that the logic state of the output is exactly the opposite of that of the input.

- **Symbol**



- **The NOT gate truth table:**

Input	Output
0	1
1	0

- **Expression: $A = \bar{A}$**

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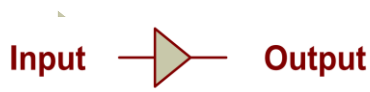
2: THE BUFFER GATE

If we were to connect two inverter gates together so that the output of one fed into the input of another, the two inversion functions would "cancel" each other out so that there would be no inversion from input to final output.

- **Symbol of a buffer gate:**



- **Truth table of the buffer gate:**

Input	Output
0	0
1	1

MULTIPLE INPUT GATES:

With a single input gate such as the inverter or buffer, there can only be two possible input states: either 1 or 0. With multiple input gates, many possibilities are available for input states. The number of possible input states is equal to two to the power of the number of inputs. So, if a gate has n inputs, therefore there are 2n possible input combinations.

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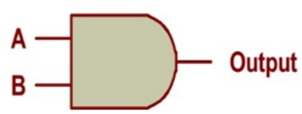
1.THE AND GATE:

The output of the AND gate is high if and only if all inputs are high. If any input is low, the output is guaranteed to be in a low state as well.

- **Truth table:**

A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

- **Symbol**

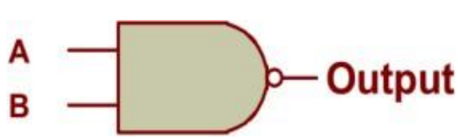


- **Expression: X = A.B**

2.THE NAND GATE:

The word NAND is a verbal contraction of the words NOT and AND. Essentially, a NAND gate behaves the same as an AND gate with a not gate connected to the output terminal.

- **Symbol**



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- **Truth table:**

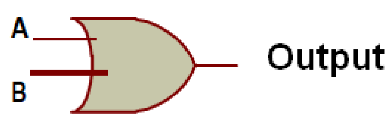
A	B	$\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

- **Expression: $X = \overline{A.B}$**

3.THE OR GATE:

The output of the OR gate is high if any of the inputs is high. The output of an OR gate goes low if and only if all inputs are low.

- **Symbol**



- **Truth table:**

A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

- **Expression: X = A + B**

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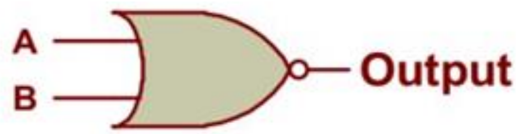
4.THE NOR GATE:

The NOR gate is an OR gate with its output inverted.

- **Symbol**



- **Truth table:**

A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

- **Expression: $X = \overline{A + B}$**

5.THE EXCLUSIVE-NOR GATE:

The exclusive-NOR gate is equivalent to an exclusive OR gate with an inverted output. The truth table is exactly opposite as for the exclusive-OR gate. The exclusive-NOR gate also known as the XNOR gate.

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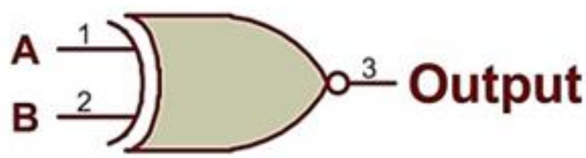
- **Symbol**



- **Truth table:**

A	B	$\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

- **Expression: $X = \overline{A \oplus B}$**

EXERCISE 1:

Draw the truth table of a three inputs AND gate.

EXERCISE 2:

Let us consider the following digital circuit:

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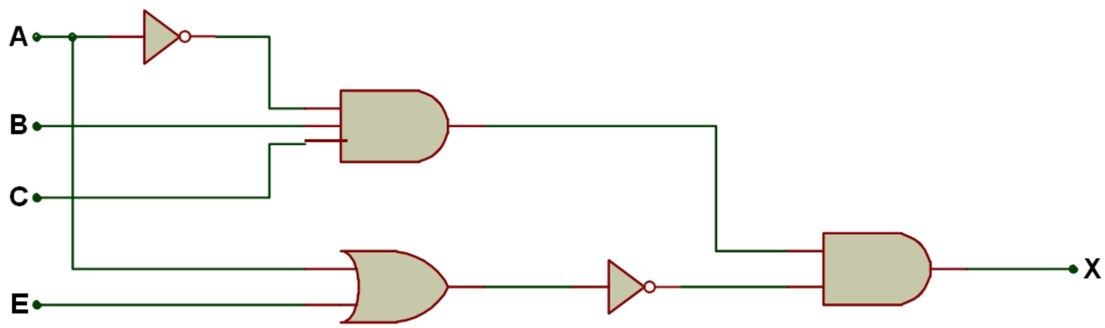

A. Give the expression of the output X.

B. Draw the truth table of the digital circuit.

EXERCISE 3:

Draw the truth table of the digital circuit described by the following equation:

$$X = AB + AB\overline{C} + \overline{AC}$$