EXPERIMENT NO 3 (GROUP A)

Aim: Study of different GATES (AND, OR, XOR), Sensors and basic binary operations**.**

Outcome: To study different GATES (AND, OR, XOR), Sensors Hardware Requirement: Logical Gates,Sensors etc.

Software Requirement: Raspbian OS

Theory:

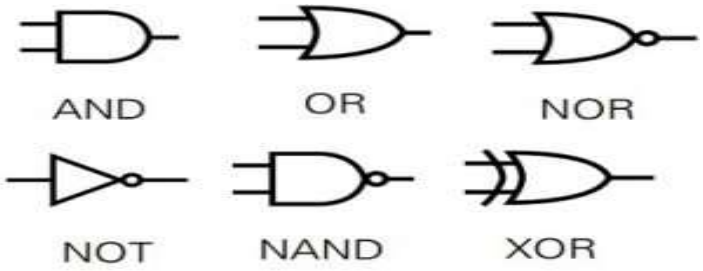
What are Basic Logic Gates?

A logic gate is a basic building block of a digital circuit that has two inputs and one output. The relationship between the i/p and the o/p is based on a certain logic. These gates are implemented using electronic switches like transistors, diodes. But, in practice, basic logic gates are built using CMOS technology, FETS, and MOSFET(Metal Oxide Semiconductor FET)s. Logic gates are used in microprocessors, microcontrollers, embedded system applications, and in electronic and electrical project circuits. The basic logic gates are categorized into seven: AND, OR, XOR, NAND, NOR, XNOR, and NOT. These logic gates with their logic gate symbols and truth tables are explained below.

Basic Logic Gates Operation

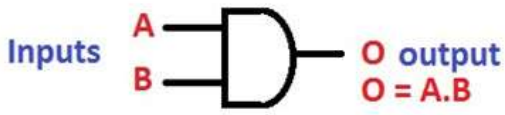
Types of Logic Gates

The different types of logic gates and symbols with truth tables are discussed below.



AND Gate

The AND gate is a digital logic gate with ‘n’ i/ps one o/p, which performs logical conjunction based on the combinations of its inputs. The output of this gate is true only when all the inputs are true. When one or more inputs of the AND gate’s i/ps are false, then only the output of the AND gate is false. The symbol and truth table of an AND gate with two inputs is shown below.



Symbol

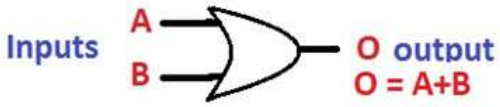
Inputs		Output
A	B	O
0	0	0
0	1	0
1	0	0
1	1	1

Truth table

AND Gate and its Truth Table

OR Gate

The OR gate is a digital logic gate with ‘n’ i/ps and one o/p, that performs logical conjunction based on the combinations of its inputs. The output of the OR gate is true only when one or more inputs are true. If all the i/ps of the gate are false, then only the output of the OR gate is false. The symbol and truth table of an OR gate with two inputs is shown below.



Symbol

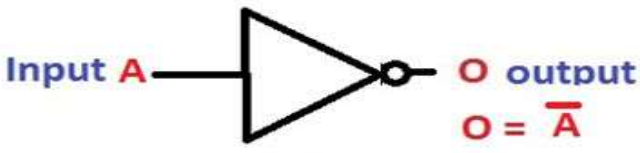
Inputs		Output
A	B	O
0	0	0
0	1	1
1	0	1
1	1	1

Truth table

OR Gate and its Truth Table

NOT Gate

The NOT gate is a digital logic gate with one input and one output that operates an inverter operation of the input. The output of the NOT gate is the reverse of the input. When the input of the NOT gate is true then the output will be false and vice versa. The symbol and truth table of a NOT gate with one input is shown below. By using this gate, we can implement NOR and NAND gates



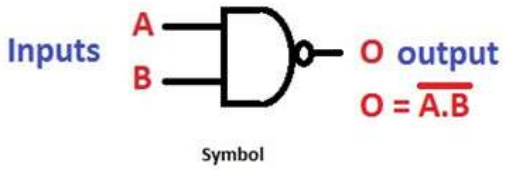
Symbol

Inputs	Output
A	O
0	1
1	0

Truth table

NAND Gate

The NAND gate is a digital logic gate with ‘n’ i/ps and one o/p, that performs the operation of the AND gate followed by the operation of the NOT gate.NAND gate is designed by combining the AND and NOT gates. If the input of the NAND gate high, then the output of the gate will be low.The symbol and truth table of the NAND gate with two inputs is shown below.



Symbol

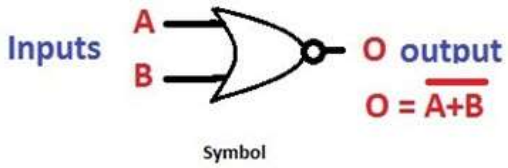
Inputs		Output
A	B	O
0	0	1
0	1	1
1	0	1
1	1	0

Truth table

NAND Gate and its Truth Table

NOR Gate

The NOR gate is a digital logic gate with n inputs and one output, that performs the operation of the OR gate followed by the NOT gate. NOR gate is designed by combining the OR and NOT gate. When any one of the i/ps of the NOR gate is true, then the output of the NOR gate will be false. The symbol and truth table of the NOR gate with the truth table is shown below.



Symbol

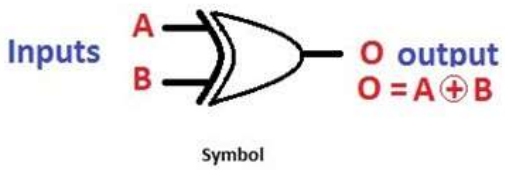
Inputs		Output
A	B	O
0	0	1
0	1	0
1	0	0
1	1	0

Truth table

NOR Gate and Its Truth Table

Exclusive-OR Gate

The Exclusive-OR gate is a digital logic gate with two inputs and one output. The short form of this gate is Ex-OR. It performs based on the operation of the OR gate. . If any one of the inputs of this gate is high, then the output of the EX-OR gate will be high. The symbol and truth table of the EX-OR are shown below.



Symbol

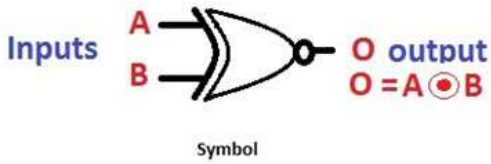
Inputs		Output
A	B	O
0	0	0
0	1	1
1	0	1
1	1	0

Truth table

EX-OR gate and Its Truth Table

Exclusive-NOR Gate

The Exclusive-NOR gate is a digital logic gate with two inputs and one output. The short form of this gate is Ex-NOR. It performs based on the operation of the NOR gate. When both the inputs of this gate are high, then the output of the EX-NOR gate will be high. But, if any one of the inputs is high (but not both), then the output will be low. The symbol and truth table of the EX-NOR are shown below.



Symbol

Inputs		Output
A	B	O
0	0	1
0	1	0
1	0	0
1	1	1

Truth table

EX-NOR Gate and Its Truth Table

The applications of logic gates are mainly determined based upon their truth table, i.e., their mode of operations. The basic logic gates are used in many circuits like a push-button lock, light-activated burglar alarm, safety thermostat, an automatic watering system, etc.

Sensors:

Sensor Classification :

Passive & Active

Analog & digital

Scalar & vector

Passive Sensor – Can not independently sense the input. Ex- Accelerometer, soil moisture, water level and temperature sensors.

Active Sensor –
Independently sense the input. Example- Radar, sounder and laser altimeter sensors.

Analog Sensor –
The response or output of the sensor is some continuous function of its input parameter. Ex- Temperature sensor, LDR, analog pressure sensor and analog hall effect.

Digital sensor –
Response in binary nature. Design to overcome the disadvantages of analog sensors. Along with the analog sensor, it also comprises extra electronics for bit conversion. Example – Passive infrared (PIR) sensor and digital temperature sensor(DS1620).

Scalar sensor –
Detects the input parameter only based on its magnitude. The answer for the sensor is a function of magnitude of some input parameter. Not affected by the direction of input parameters.
Example – temperature, gas, strain, color and smoke sensor.

Vector sensor –
The response of the sensor depends on the magnitude of the direction and orientation of input parameter. Example – Accelerometer, gyroscope, magnetic field and motion detector sensors.

Types of sensors –

Electrical sensor :

Electrical proximity sensors may be contact or non contact.

Simple contact sensors operate by making the sensor and the component complete an electrical circuit.

Non- contact electrical proximity sensors rely on the electrical principles of either induction for detecting metals or capacitance for detecting non metals as well.

Light sensor:

Light sensor is also known as photo sensors and one of the important sensor.

Light dependent resistor or LDR is a simple light sensor available today.

The property of LDR is that its resistance is inversely proportional to the intensity of the ambient light i.e when the intensity of light increases, it's resistance decreases and vise versa.

Touch sensor:

Detection of something like a touch of finger or a stylus is known as touch sensor.

It's name suggests that detection of something.

They are classified into two types:

Resistive type

Capacitive type

Today almost all modern touch sensors are of capacitive types.

Because they are more accurate and have better signal to noise ratio.

Range sensing:

Range sensing concerns detecting how near or far a component is from the sensing position, although they can also be used as proximity sensors.

Distance or range sensors use non-contact analog techniques. Short range sensing, between a few millimetres and a few hundred millimetres is carried out using electrical capacitance, inductance and magnetic technique.

Longer range sensing is carried out using transmitted energy waves of various types eg radio waves, sound waves and lasers.

Mechanical sensor:

Any suitable mechanical / electrical switch may be adopted but because a certain amount of force is required to operate a mechanical switch it is common to use micro-switches.

Pneumatic sensor:

These proximity sensors operate by breaking or disturbing an air flow.

The pneumatic proximity sensor is an example of a contact type sensor. These cannot be used where light components may be blown away.

Optical sensor:

In there simplest form, optical proximity sensors operate by breaking a light beam which falls onto a light sensitive device such as a photocell. These are examples of non contact sensors. Care must be exercised with the lighting environment of these sensors for example optical sensors can be blinded by flashes from arc welding processes, airborne dust and smoke clouds may impede light transmission etc.

Speed Sensor:

Sensor used for detecting the speed of any object or vehicle which is in motion is known as speed sensor .For example – Wind Speed Sensors, Speedometer ,UDAR ,Ground Speed Radar .

Temperature Sensor:

Devices which monitors and tracks the temperature and gives temperature's measurement as an electrical signal are termed as temperature sensors .These electrical signals will be in the form of voltage and is directly proportional to the temperature measurement .

PIR Sensor:

PIR stands for passive infrared sensor and it is an electronic sensor that is used for the tracking and measurement of infrared (IR) light radiating from objects in its field of view and is also known as Pyroelectric sensor .It is mainly used for detecting human motion and movement detection .

Ultrasonic Sensor:

The principle of ultrasonic sensor is similar to the working principle of SONAR or RADAR in which the interpretation of echoes from radio or sound waves to evaluate the attributes of a target by generating the high frequency sound waves .

Conclusion:

