NE-3102: Electronics-II Laboratory

Roll _____ Date _____ Experiment No. _____

Name of the experiment

Construction of basic gates (AND, OR & NOT) using discrete components (Resistor, Diode, Transistor etc.) & the verification of the truth table of the constructed gates.

Contents

1 Objective

1. To construct basic logic gates using discrete components.
2. To study and verify associated truth tables.

2 Theory

AND, OR, and NOT gates are basic logic gates. Digital circuits called logic gates can be constructed from diodes, transistors, and resistors connected so that the circuit output is the result of a basic logic operation (OR, AND, NOT) performed on the inputs. Inputs and Outputs of logic gates can occur only on two levels. These two levels are termed HIGH and LOW, or TRUE and FALSE, or ON and OFF, or 1 and 0.

2.1 OR gate

In digital circuitry, an OR gate is a circuit that has two or more inputs and whose output is equal to the OR combination of the inputs. Figure 1 is the logic symbol for a two-input OR gate. The inputs A and B are logic voltage levels, and the output x is a logic voltage level whose value is the result of the OR operation on A and B; that is, $x = A + B$. In other words, the OR gate operates so that its output is HIGH (logic 1) if either input A or B or both are at a logic 1 level. The OR gate output will be LOW (logic 0) only if all its inputs are at logic 0.

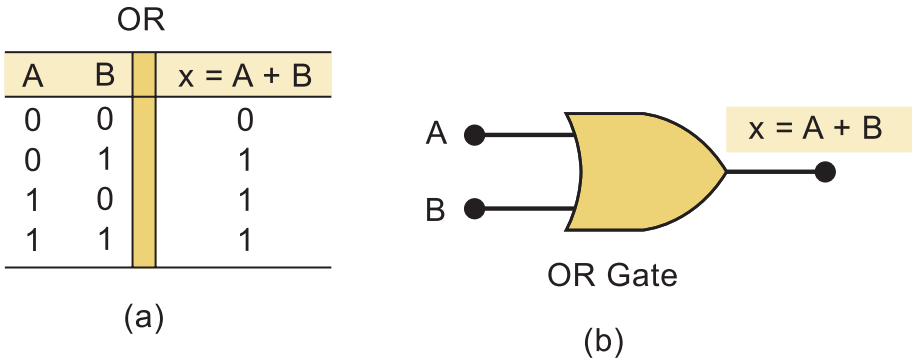

Figure 1: OR gate.

Summery of OR operation:

1. The OR operation produces a result (output) of 1 whenever any input is a 1. Otherwise, the output is 0.
2. An OR gate is a logic circuit that performs an OR operation on the circuit's inputs.
3. The expression $x = A + B$ is read as "x equals A OR B."

2.2 AND gate

The logic symbol for a two-input AND gate is shown in Figure 2. The AND gate output is equal to the AND product of the logic inputs; that is, $x = AB$. In other words, the AND gate is a circuit that operates so that its output is HIGH only when all its inputs are HIGH. For all other cases, the AND gate output is LOW.

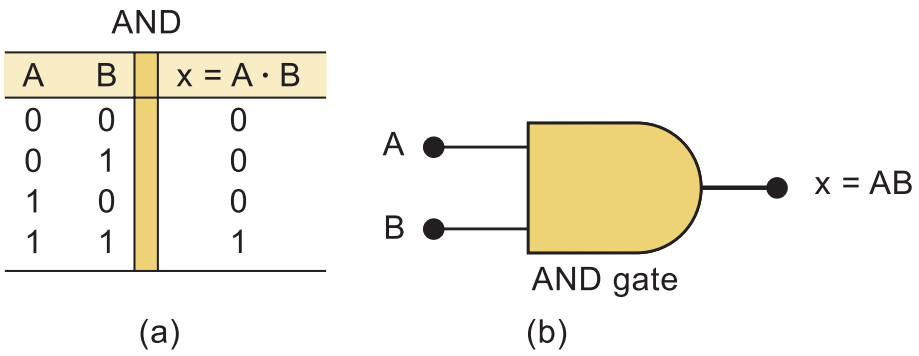

Figure 2: AND gate.

Note the difference between the symbols for the AND gate and the OR gate. Whenever you see the AND symbol on a logic-circuit diagram, it tells you that the output will go HIGH only when all inputs are HIGH. Whenever you see the OR symbol, it means that the output will go HIGH when any input is HIGH.

Summary of the AND Operation:

1. The AND operation is performed the same as ordinary multiplication of 1s and 0s.
2. An AND gate is a logic circuit that performs the AND operation on the circuit's inputs.
3. An AND gate output will be 1 only for the case when all inputs are 1 ; for all other cases, the output will be 0.
4. The expression $x = AB$ is read as "x equals A AND B."

2.3 NOT gate

A NOT gate is more commonly called an INVERTER. Figure 3 shows the symbol for a NOT circuit, which is $x = \bar{A}$. This circuit always has only a single input, and its output logic level is always opposite to the logic level of this input. Figure 3-11(c) shows how the INVERTER affects an input signal. It inverts (complements) the input signal at all points on the waveform so that whenever the input = 0, output = 1, and vice versa.

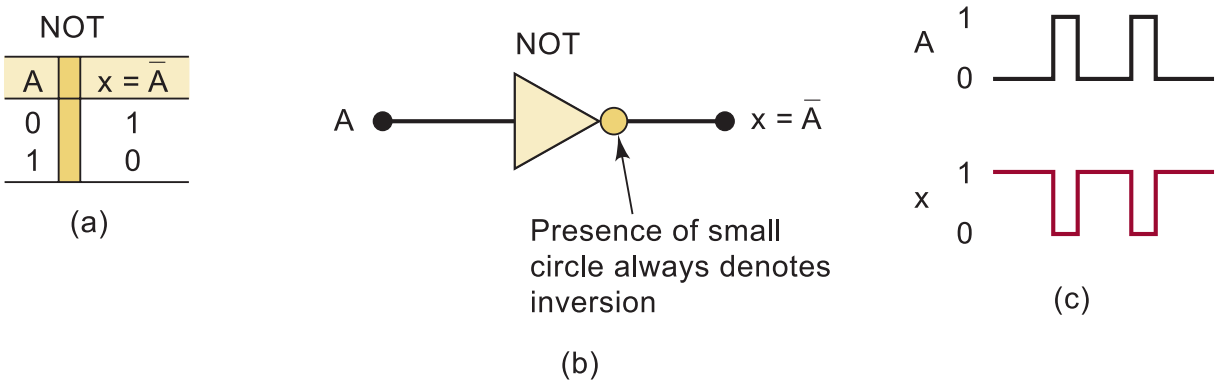

Figure 3: NOT gate.

3 Components and apparatus

1. Passive components
2. Breadboard and connecting wires
3. Bench power supply

4 Circuit diagram/setup

5 Data collection and analysis

Input		Output	
A	B	X	Voltage, $V_0(v)$
0	0	0	0.57
0	1	1	4.34
1	0	1	4.34
1	1	1	4.39

Table 1: Truth table for OR gate.

Input		Output	
A	B	X	Voltage, V_o(v)
0	0	0	0.70
0	1	0	0.78
1	0	0	0.79
1	1	1	4.97

Table 2: Truth table for AND gate.

Input	Output	
A	X	Voltage, $V_o(v)$
0	1	4.56
1	0	0.42

Table 3: Truth table for NOT gate.

6 Result

7 Discussion

8 References

1. Tocci Ronald J, Neal W, Greg M. Digital Systems Principles and Applications.

Appendix