Semiconductor Electronics- III

Logic gates

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Binary logic

In digital circuits only two states are defined

(a) High or 1 or true

(b) Low or 0 or false

Note : A low state may be of 0V and a high state may be of 5V (and not necessarily 0V and 1V respectively)

Logic gates

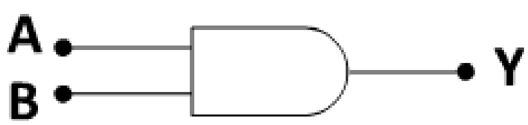
Basic building blocks of digital electronics are called Logic Gates. These process the digital signals in a specific manner. Logic gates are used in calculators, digital watches, computers, robots, industrial control systems, and in telecommunications.

AND gate	**NAND** gate
OR gate	**NOR** gate
NOT gate	**XOR** gate

AND gate

Output is high if both the inputs <u>A and B</u> are high

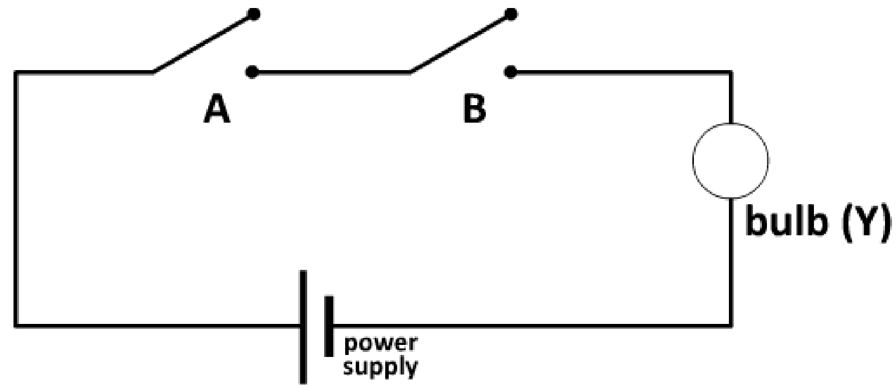
Circuit symbol



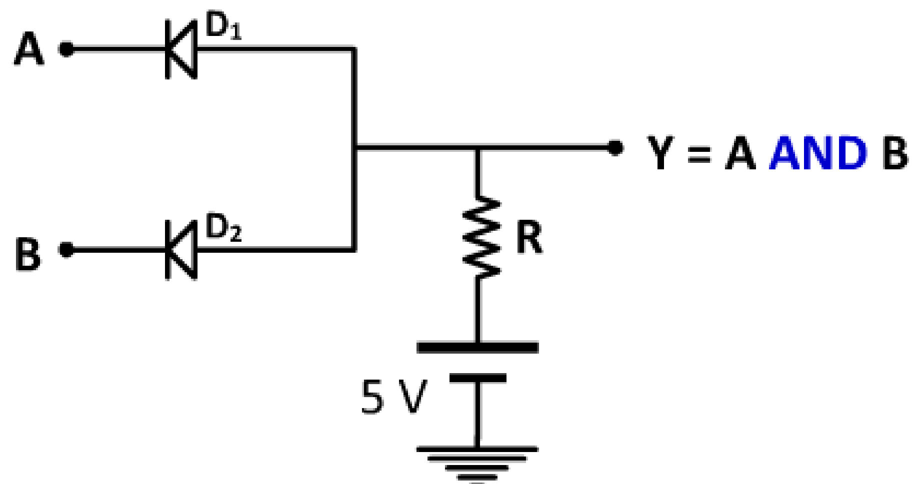
Truth table

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Implementation using switches



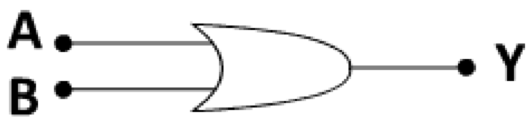
Implementation using diodes



OR gate

Output is high if either input A <u>or</u> input B is high

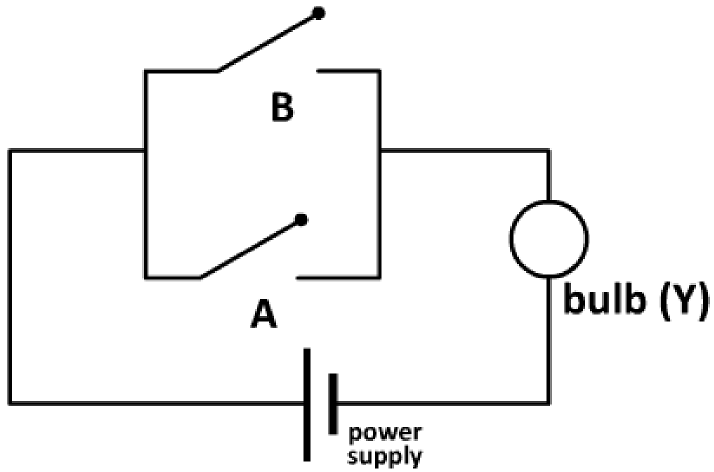
Circuit symbol



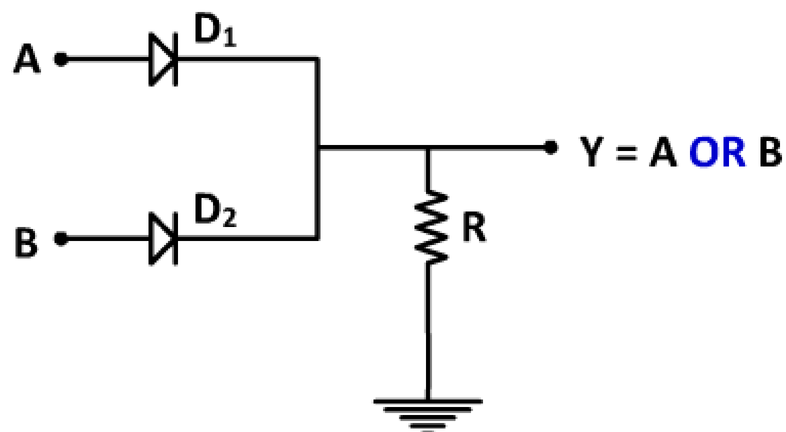
Truth table

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Implementation using switches



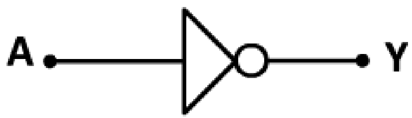
Implementation using diodes



NOT gate

Output is not the same as the input

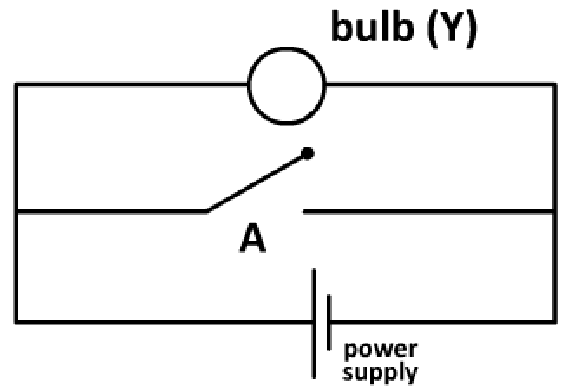
Circuit symbol



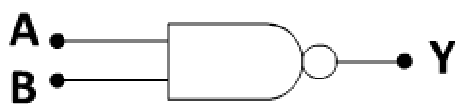
Truth table

A	Y
1	0
0	1

Implementation using switches



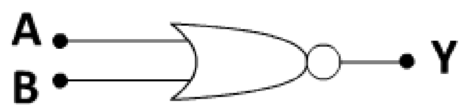
NAND gate



Truth table

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

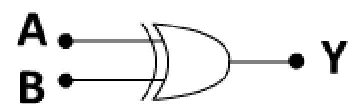
NOR gate



Truth table

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

XOR gate



Truth table

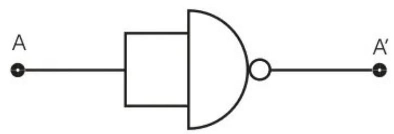
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

Universal gates

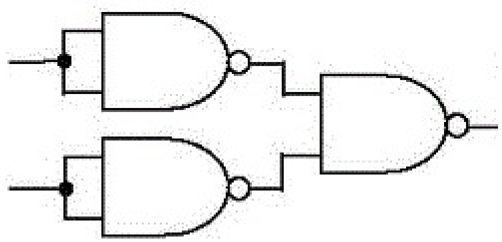
NAND and NOR gates are considered as universal gates

NAND gate as universal gates

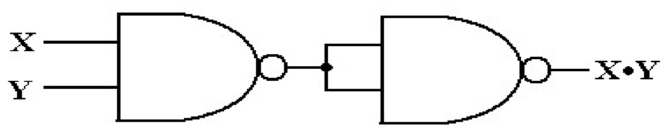
NAND gate as NOT gate



NAND gates as OR gate



NAND gates as AND gate

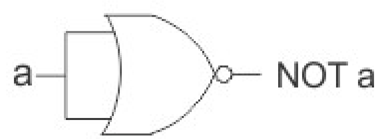


Universal gates

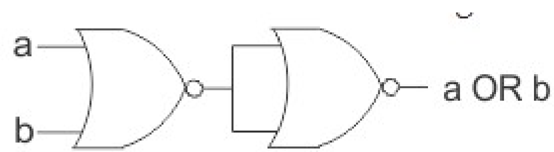
NAND and NOR gates are considered as universal gates

NOR gate as universal gates

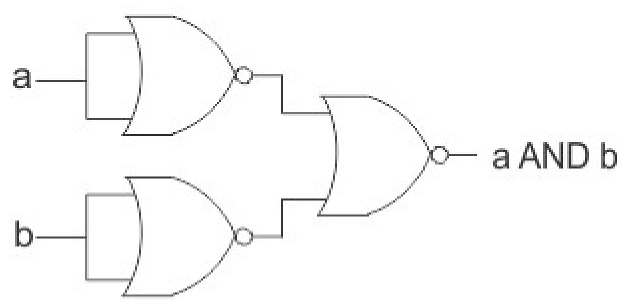
NOR gate as NOT gate



NOR gates as OR gate



NOR gates as AND gate



De Morgan's theorems (for logic gates)

De Morgan´s Theorem can be used to find the equivalency of NAND and NOR gates

First theorem : $\overline{A \bullet B} = \overline{A} + \overline{B}$

Second theorem : $\overline{A + B} = \overline{A} \bullet \overline{B}$

Inputs		Truth Table Outputs For Each Term				
B	A	A.B	$\overline{A.B}$	$\overline{A}$	$\overline{B}$	$\overline{A}+\overline{B}$
0	0	0	1	1	1	1
0	1	0	1	0	1	1
1	0	0	1	1	0	1
1	1	1	0	0	0	0

Inputs		Truth Table Outputs For Each Term				
B	A	A+B	$\overline{A+B}$	$\overline{A}$	$\overline{B}$	$\overline{A}.\overline{B}$
0	0	0	1	1	1	1
0	1	1	0	0	1	0
1	0	1	0	1	0	0
1	1	1	0	0	0	0

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