

Boolean Algebra And Logic Gates

MARCH

2024

M T W T F S S M T W T F S S

1 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31

2024

Monday

FEBRUARY

26

Logic is a reasoning which indicates, in present reference, that a certain statement is true if certain conditions are true, e.g., output of a circuit is such if inputs are such AND/OR such etc.

Logic Gates :-

It is a digital circuit which takes logical decisions. It can have one or more input signals but only one output signal. The type of output is dependent on the inputs for a particular gate.

The operation of a logic gate may be described by a truth table or Boolean Algebra. The inputs and output of a gate circuit when written in the form of a table then such a table is called Truth Table.

Digital (logic) circuits operate in the binary mode where each input and output voltage is either a 0 or a 1. Digit 0 and 1 represent pre-defined voltage ranges e.g., 0 indicating 0 volt and 1 indicating 5.0 volt. The other terms used to describe these states are true or false, high or low, ON or OFF, closed or open.

Boolean Algebra :

It is a tool for analysing and designing a digital system. The algebra used to describe logical relations is called Boolean algebra.

27

2024

Tuesday

FEBRUARY

2024

FEBRUARY

M T W T F S S M T W T F S S

1 2 3 4 5 6 7 8 9 10 11

12 13 14 15 16 17 18 19 20 21 22 23 24 25

26 27 28 29

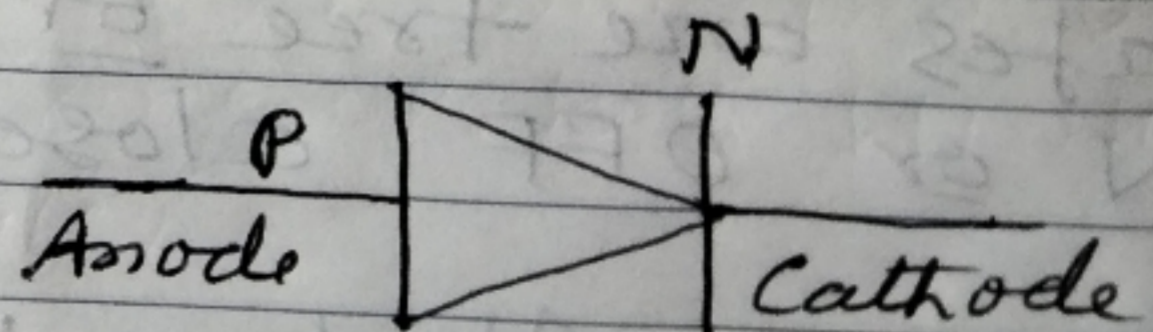
The main logic functions of Boolean algebra are:

AND, denoted by dot \cdot sign e.g. $A \cdot B$ (A AND B)
 OR, denoted by Plus $+$ sign e.g. $A + B$ (A OR B)
 NOT, denoted by a bar sign e.g. \bar{A} (NOT A)

Logic gates are Combinational logic circuit whose output depends only on external inputs. But when in addition to external inputs, output also depends upon the states of memory element accounting for the previous state of the output of the circuit - (which is the memory of previous inputs) then such a circuit is called sequential logic circuit (e.g. flip flops).

Binary States 1, 0 as they refer to electronic circuit and their operation:

(A) In case of a diode: if P is at a higher potential than N (P is at 5.0V and N is at 0V) then diode is forward biased, diode is in ON state. Voltage applied at P is 5.0V (say), referred to by 1 in binary.



fig

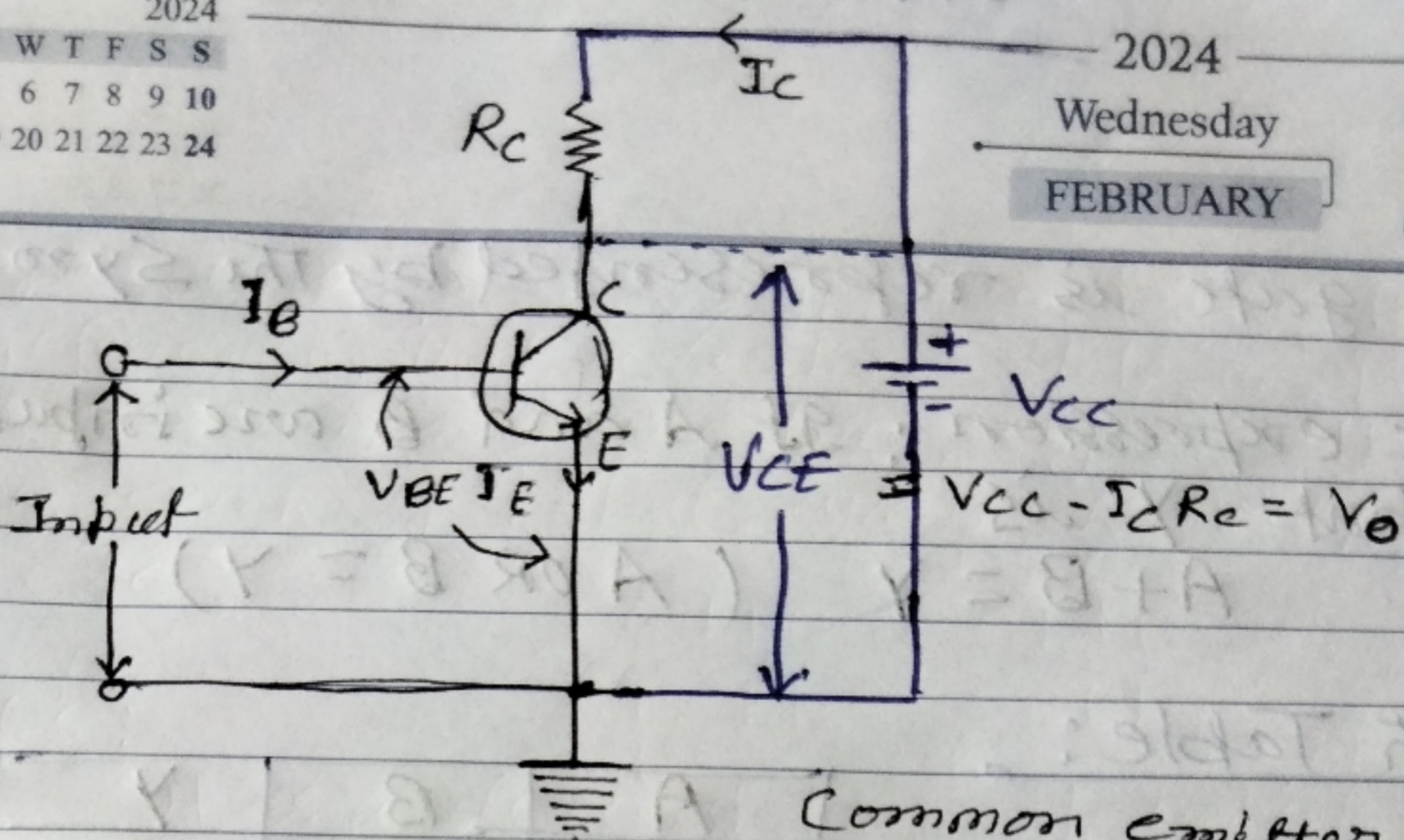
In case of Silicon diode

0.7 volt and for Ge

diode 0.3 volt at P is

required to overcome the junction barrier so that diode may be switched ON

P-N Junction diode



2.) In case of a transistor (Common emitter configuration)

(i) If input is at 5.0 Volt (i.e. state-1 of binary) then base-emitter junction is forward biased, base current I_B flows. So, collector current I_C flows. As input is much more than junction barrier voltage (0.7V), I_B is sufficient, I_C goes to its full value so that transistor goes into saturation. Then output falls LOW (about 0.2 Volt, say 0 Volt) as product $I_C R_C$ is large.

Input Binary State	Circuit	output	output Voltage	Binary state
5.0 Volt	ON Saturation	LOW	0V	0

(ii) If input is 0 Volt (0 State of binary) then B-E junction is reverse biased $I_B = 0$ so $I_C = 0$ Then $I_C R_C = 0$ and output is HIGH (5.0V = V_{CC}).

Input Binary State	Circuit	output	output Voltage	Binary state
0	OFF	HIGH	5.0V	1

OR Gate

2024
29

Thursday

FEBRUARY

2024

FEBRUARY

MTWTFSSMTWTFSS
1 2 3 4 5 6 7 8 9 10 11
12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29

This gate is represented by the symbol +,

Logic expression: If A and B are inputs then output Y is

$$A + B = Y \quad (A \text{ OR } B = Y)$$

Truth Table:

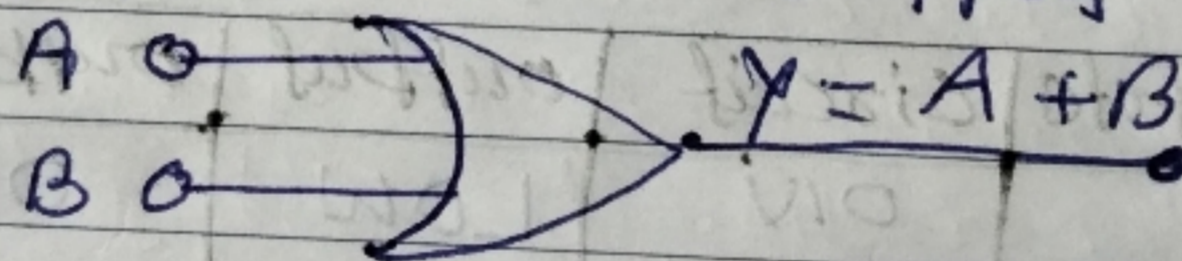
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

We note from truth table of OR gate that if any input is a 1, output is a 1. Thus OR gate is a logic gate in which the output is HIGH if any or all the inputs are HIGH.

Symbol.

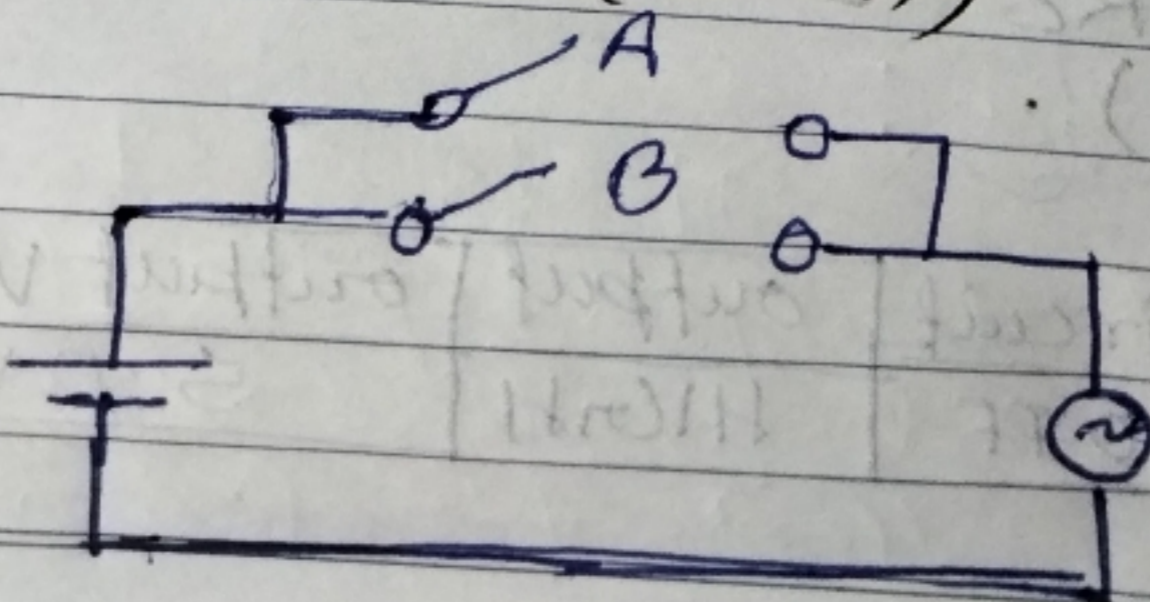
Inputs

output-



OR gate symbol

Electrical analog: If A is connected or B is connected i.e. one or both HIGH then bulb will glow (HIGH)



Electric analog of OR gate.