ROORKEE COLLEGE OF ENGINNERING, ROORKEE

B.TECH. – ELECTRICAL & ELECTRONICS ENGINEERING

PROJECT ORIENTATION PROGRAMME

SESSION - 2017-18

IMPLEMENTATION OF LOGIC GATE USING TRANSISTOR

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ABSTRACT

Although RTL stays away from all these logic families, it is still interesting to see if there is some connection between them... some common general idea... Let's try to find it...
Remember that in RTL we summed voltages by converting them to currents. But this circuit was sensitive to the magnitudes of the voltages and resistances; in addition, the number of inputs was limited. It seems we can sum, besides voltages and currents, why not resistances as well?
Here is the implementation.
The input logic variables turn on (at logic "1") or turn off (at logical "0") equal reference resistances (conductance).They are summed by an analog summer again.
Their sum is converted to voltage and compared by a threshold device (voltage comparator) whose threshold is lower than one reference. So it is sufficient that only one reference is turned on and the output is set at logic state "1".

This idea is taken to the extreme in the classic DL, DTL, TTL, MOS and CMOS circuits where the reference resistances are increased up to infinity. In practice, they are implemented by diode or transistor switches operated by the logic input variables.
They are connected in series to sum the switch resistances or in parallel to sum their conductance (DL, DTL and TTL use only a parallel connection).

INTRODUCTION

A gate is defined as a digital circuit which follows some logical relationship between the input and output voltages. It is a digital circuit which either allows a signal to pass through as stop, it is called a gate. The logic gates are building blocks at digital electronics. They are used in digital electronics to change on voltage level (input voltage) into another (output voltage) according to some logical statement relating them. A logic gate may have one or more inputs, but it has only one output. The relationship between the possible values of input and output voltage is expressed in the form of a table called truth table or table of combinations. Truth table of a Logic Gates is a table that shows all the input and output possibilities for the logic gate. George Boole in 1980 invented a different kind of algebra based on binary nature at the logic, this algebra of logic called BOOLEAN ALGEBRA. A logical statement can have only two values, such as HIGH/LOW, ON/OFF,CLOSED/OPEN, YES/NO, RIGHT/WRONG, TRUE/FALSE,CONDUCTING/NON-CONDUCTING etc. The two values oflogic statements one denoted by the binary number 1 and 0.The binary number 1 is used to denote the high value. The logical statements that logic gates follow are called Boolean expressions

PRINCIPLE:

Any Boolean algebra operation can be associated with inputs and outputs represent the statements of Boolean algebra. Although these circuits may be complex, they may all be constructed from three basic devices. We have three different types of logic gates. These are the AND gate, the OR gate and the NOT gate.

LOGIC STATES	
HIGH	LOW
1	0
+V	0V
ON	OFF
CLOSE	OPEN
RIGHT	WRONG

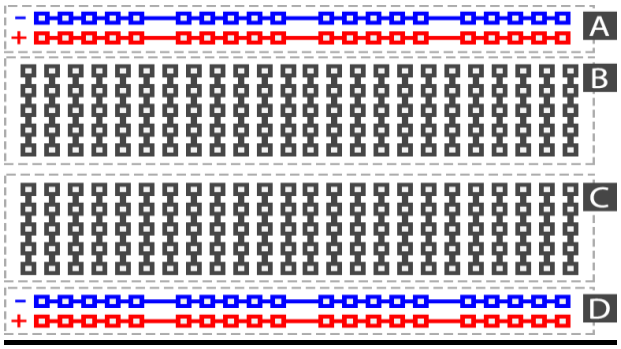
TRUE	FALSE
YES	NO

OBJECTIVE – TO IMPLEMENT THE LOGIC NAND GATE USING NPN TRANSISTOR.

Components Required –

✓ BREADBOARD

A breadboard is a solder less device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard has strips of metal underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.



✓RESISTORS

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

✓LED (LIGHT EMITTING DIODE)

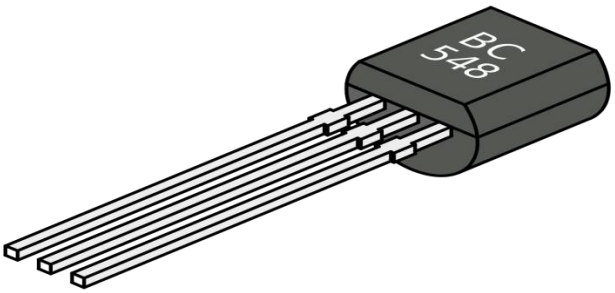
A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable current is applied to the leads,

Electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm2) and integrated optical components may be used to shape the radiation pattern.

✓NPN TRANSISTOR(BC548)

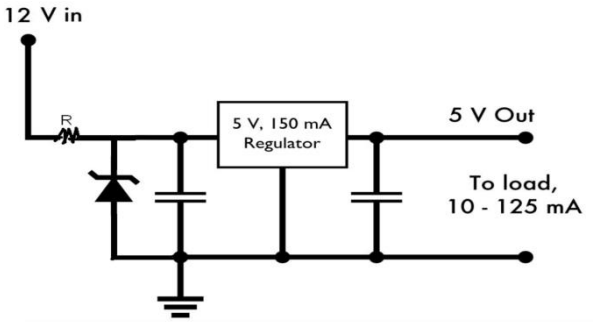
The BC548 is a part of a family of NPN and PNP epitaxial silicon transistors that originated with the metal-cased BC108 family of transistors. This series, introduced in 1966 by Philips, became the most used transistors in Australia and was taken up by many European manufacturers. The BC548 is the modern plastic-packaged BC108 the BC548 article at the Radiomuseum website describes the BC548 as a successor to the BC238 and differing from the BC108 in only the shape of the package. Datasheets for the BC548 give specifications that are identical to, or exceed, those of the BC108, BC148 and BC238 predecessors. Thus the BC548 (or BC546 to 550) is a valid substitute in any circuit designed for the older BC108 (or BC148), which includes many Mullard and Philips published designs. citation needed

As of 2016, the BC548 is principally produced by ON Semiconductor and Fairchild Semiconductor.

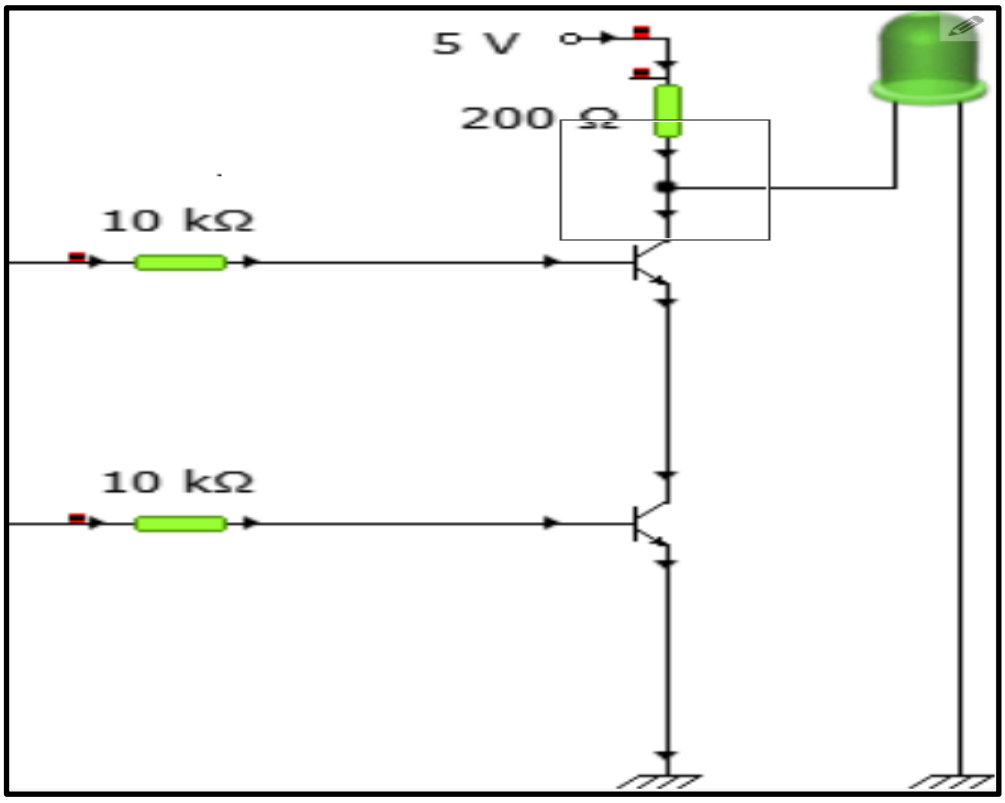


✓VOLTAGE REGULATION IC 7805

78xx (sometimes L78xx, LM78xx, MC78xx...) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost.



Circuit Details :-



Concept about NAND GATE :-

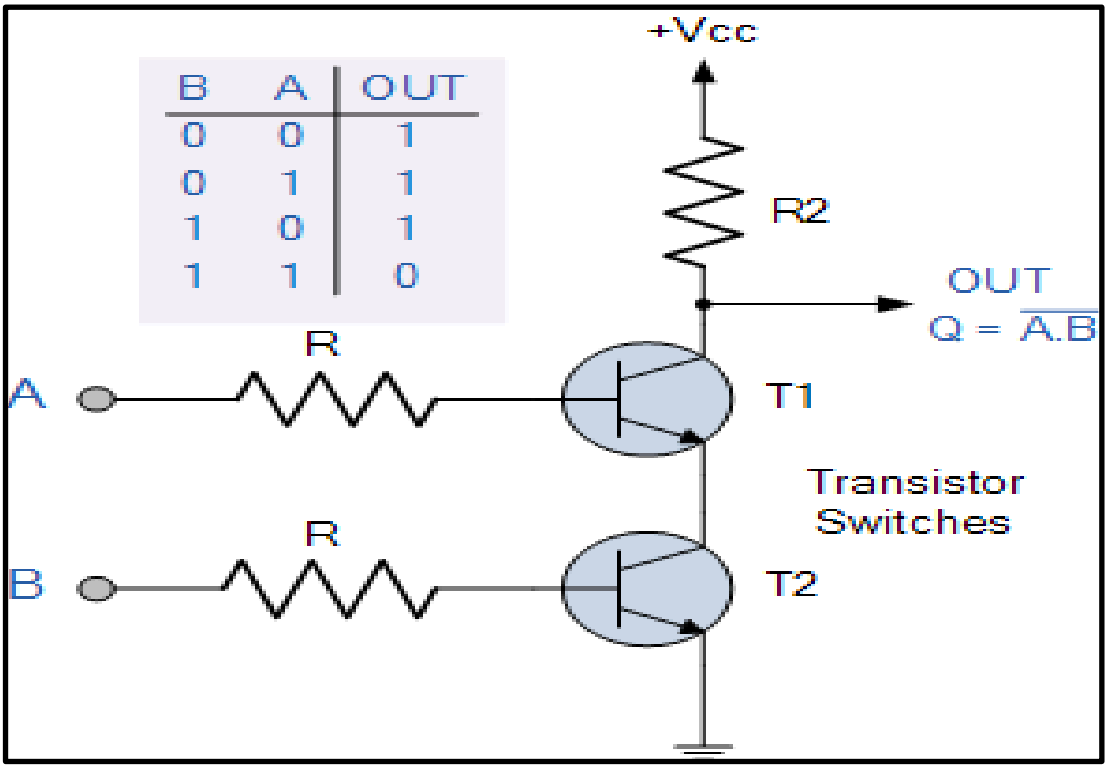
The NAND (Not – AND) gate has an output that is normally at logic level “1” and only goes “LOW” to logic level “0” when **ALL** of its inputs are at logic level “1”. The **Logic NAND Gate** is the reverse or “*Complementary*” form of the AND gate.
The logic or Boolean expression given for a logic NAND gate is that for *Logical Addition*, which is the opposite to the AND gate, and which it performs on the *complements* of the inputs. The Boolean expression for a logic NAND gate is denoted by a single dot or full stop symbol, (.) with a line or *Overline*, (¯) over the expression to signify the NOT or logical negation of the NAND gate giving us the Boolean expression of: $\overline{A.B} = Q$.

Then we can define the operation of a 2-input digital logic NAND gate as being:

“If either A or B are NOT true, then Q is true”

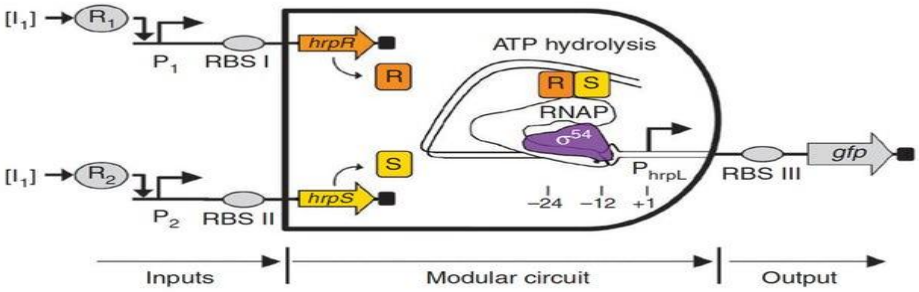
TRANSISTOR NAND GATE –

A simple 2-input logic NAND gate can be constructed using RTL Resistor-transistor switches connected together as shown below with the inputs connected directly to the transistor bases. Either transistor must be cut-off “OFF” for an output at Q.



Logic NAND Gates are available using digital circuits to produce the desired logical function and is given a symbol whose shape is that of a standard AND gate with a circle, sometimes called an “inversion bubble” at it’s output to represent the NOT gate symbol with the logical operation of the NAND gate given as.

SCOPES: BIOLOGICAL LOGIC GATES FOR BIOLOGICAL COMPUTERS



DNA is often referred to as the building block of life. New scientists from Imperial College London have demonstrated that DNA (and bacteria) can be used to create the fundamental building blocks of a computer - logic gates. Using DNA and harmless gut bacteria, the scientists have built what they claim are the most advanced biological logic gates ever created by scientists. The research could lead to the development of a new generation of microscopic biological computing devices that, amongst other things, could travel around the body cleaning arteries and destroying cancers.

While previous research had already proven biological logic gates could be made, the Imperial College scientists say the big advantage of their creations is that they behave like their electronic counterparts - replicating the way that electronic logic gates process information by either switching "on" or "off." Importantly, the new biological logic gates are also modular, meaning they could be fitted together to make different types of logic gates and more complex biological processors.

To create a type of logic gate called an "AND gate," the team used modified DNA to reprogram Escherichia Coli (E.Coli) bacteria to perform the same switching on and off process as its electronic equivalent when stimulated by chemicals. In a similar way to the way electronic components are made, the team demonstrated that the biological gates could be connected together to form more complex components.

The team also created a "NOT gate" and combined it with the AND gate to produce the more complex "NAND gate." NAND gates are significant because any Boolean function (AND, OR, NOT, XOR, XNOR), which play a basic role in the design of computer chips, can be implemented by using a combination of NAND gates.

The researchers will now try and develop more complex circuitry that comprises multiple logic gates. To accomplish this they will need to find a way to link multiple biological logic gates together that is similar to the way in which electronic logic gates are linked together to enable complex processing to be carried out.

"We believe that the next stage of our research could lead to a totally new type of circuitry for processing information," said Professor Martin Buck from the Department of Life Sciences at Imperial College London. "In the future, we may see complex biological circuitry processing information using chemicals, much in the same way that our body uses them to process and store information."

The team also suggests that these biological logic gates could one day form the building blocks of microscopic biological devices, such as sensors that swim inside arteries, detecting the build up of harmful plaque and rapidly delivering medications to the affected area. Other sensors could detect and destroy cancer cells inside the body, while others could be deployed in the environment to monitor pollution and detect and neutralize dangerous toxins.

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