TUT-I

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Objectives

- Number Systems
- Truth table
- Logic Gates: logical expressions and ICs
- Extension of inputs
- Logic High/Low
- Input to Logic Circuit
- Output of Logic Circuit
- Nomenclature of IC s
- Subfamilies of Ics(74XXX)
- Device functions of IC s 74XXX
- Boolean Expression of a logic circuit
- Logic Circuit design using Truth Table
- Alternate Logic representation

Number Systems

- Perform following conversion
  - 771 (Decimal to Octal)
  - 43 (Decimal to Hexadecimal)
  - 43 (Decimal to BCD)
  - 1204 (Octal to Decimal)
  - 165 (Octal to Binary)

Number Systems

- A black and white digital Camera lays a fine grid over an image and then measures and records a binary number representing the level of gray it sees in each cell of the grid. For example, if four bit numbers are used black is set to 0000 and white to 1111. If six, black is 000000 and white is 111111, and all grays are between the two. Suppose we wanted to distinguish among 254 different levels of gray within each cell of the grid. How many bits would we need to use to represent these levels

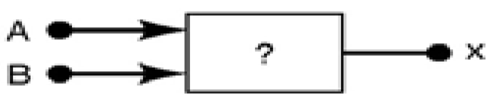
Truth Tables

- How a logic circuit's output depends on the logic levels present at the inputs.

Inputs

Output

A	B	x
0	0	1
0	1	0
1	0	1
1	1	0



(a)

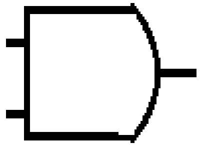
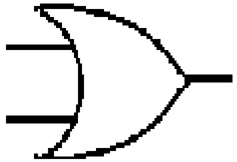
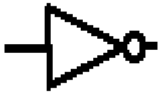
A	B	C	x
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

(b)

A	B	C	D	x
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

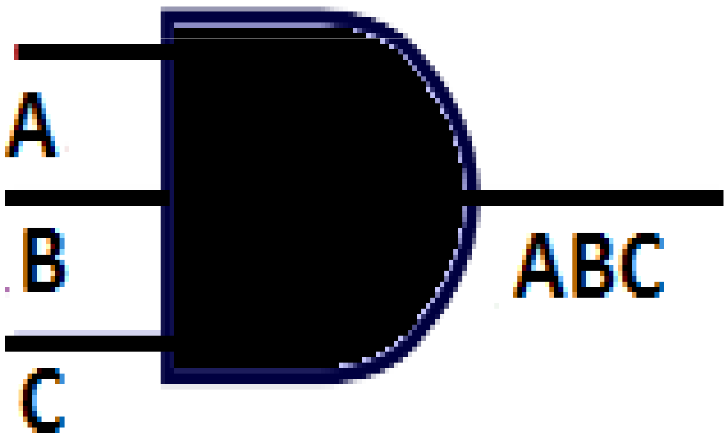
(c)

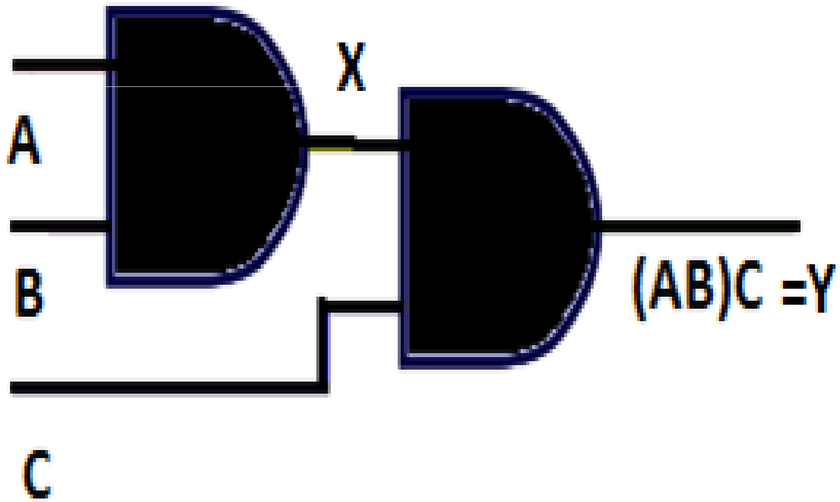
Logic gates
(logical expression and ICs)

AND	**A.B**		7408
OR	**A+B**		7432
NOT	**A’**		7404

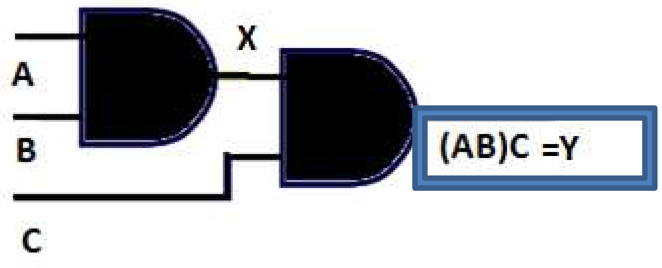
Write truth tables for all above three logic gates.

Extension to multiple inputs





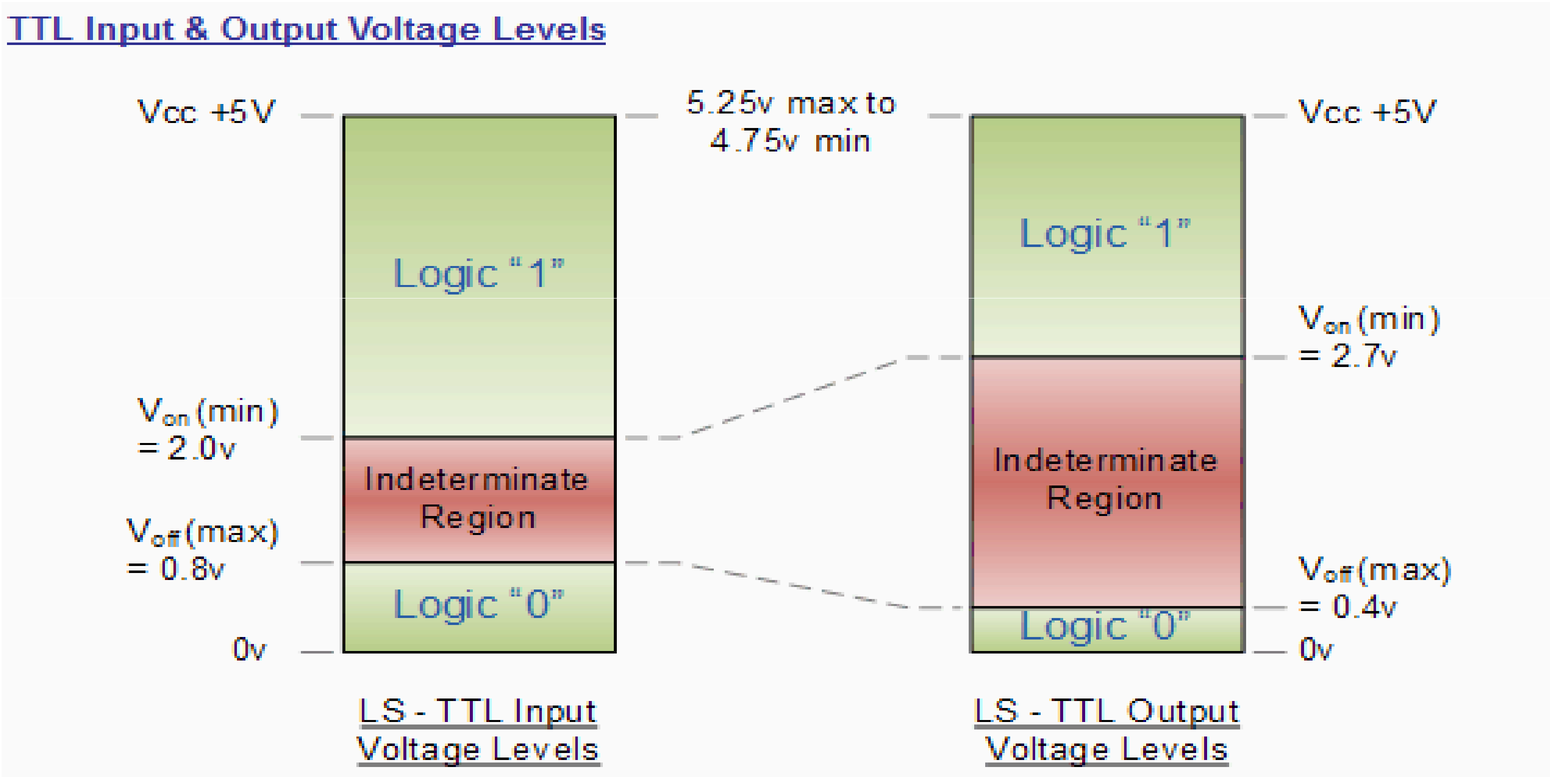
Truth Table of A Simple Logic Circuit



A	B	X=AB	C	Y=ABC	Description/ Logic of circuit
0	0	0	0	0	
0	0	0	1	0	
0	1	0	0	0	
0	1	0	1	0	
1	0	0	0	0	
1	0	0	1	0	
1	1	1	0	0	
1	1	1	1	1	A.B.C

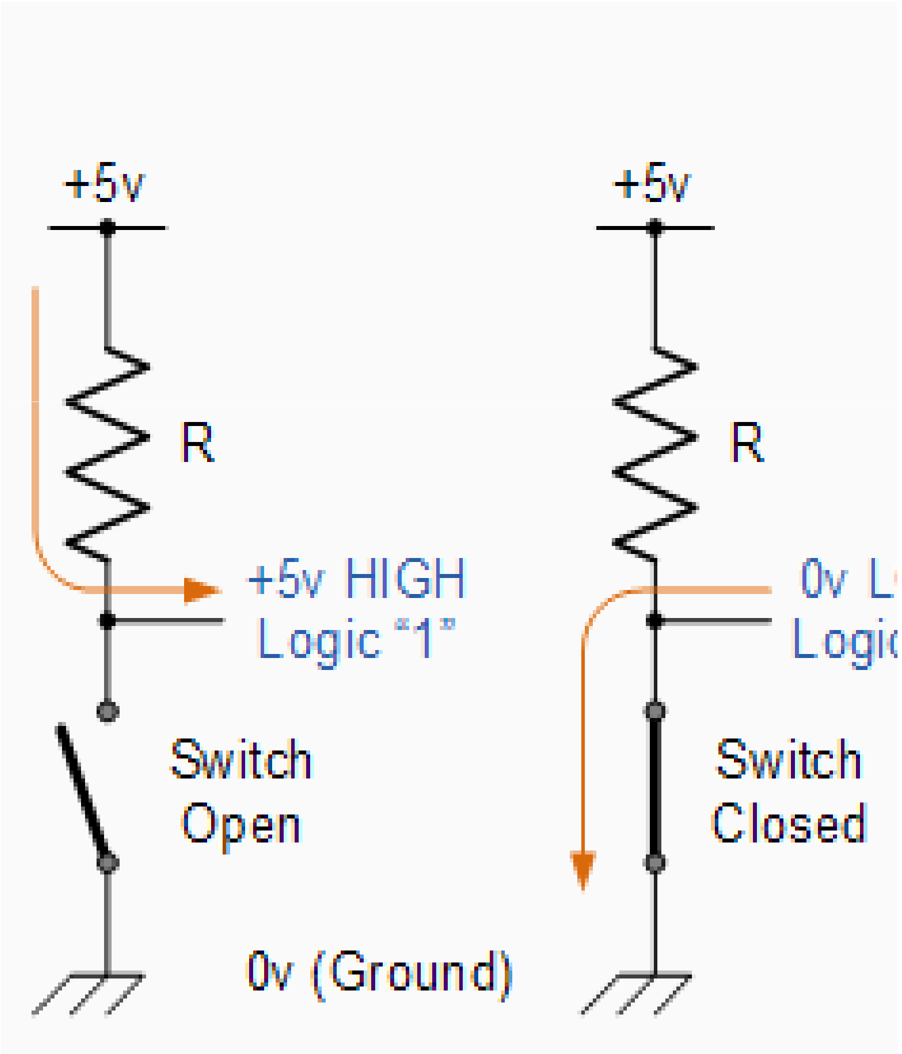
Logic H/L

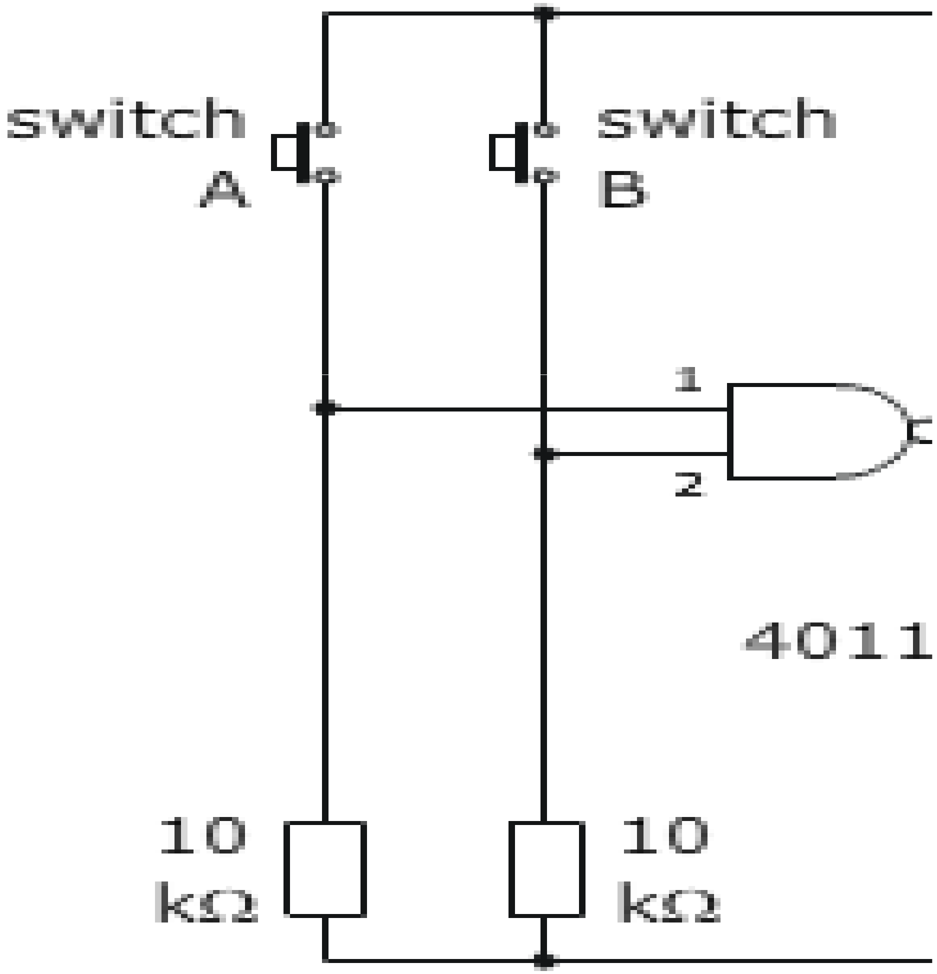
- The exact switching voltage required to produce either a logic "0" or a logic "1" depends upon the specific logic group or family.



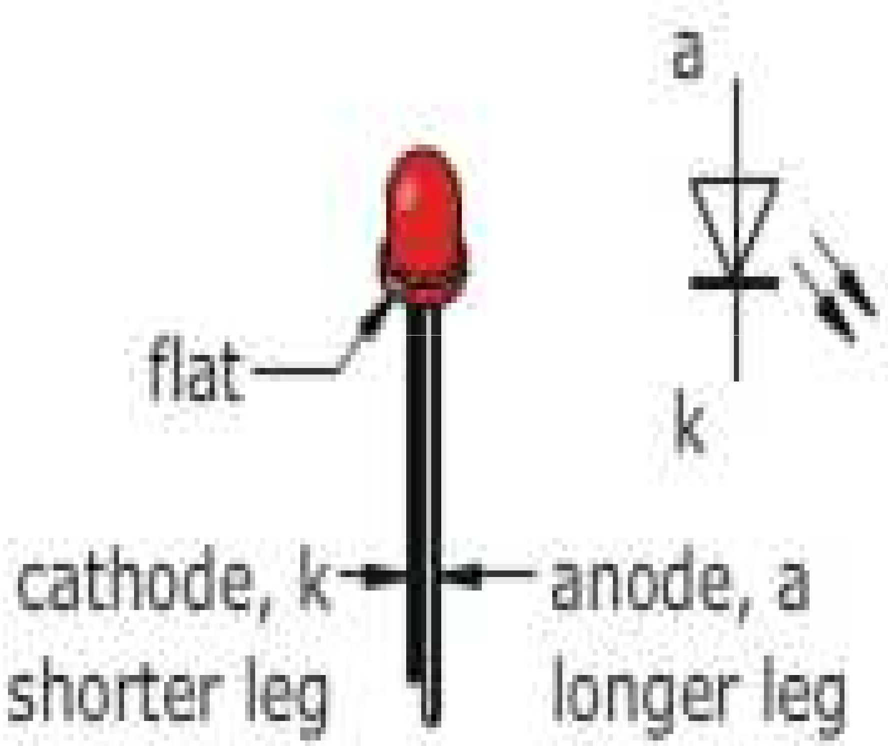
- The CMOS 4000 logic family uses a logic "1" level operating between 3.0 and 18 volts and a logic "0" level below 1.5 volts.

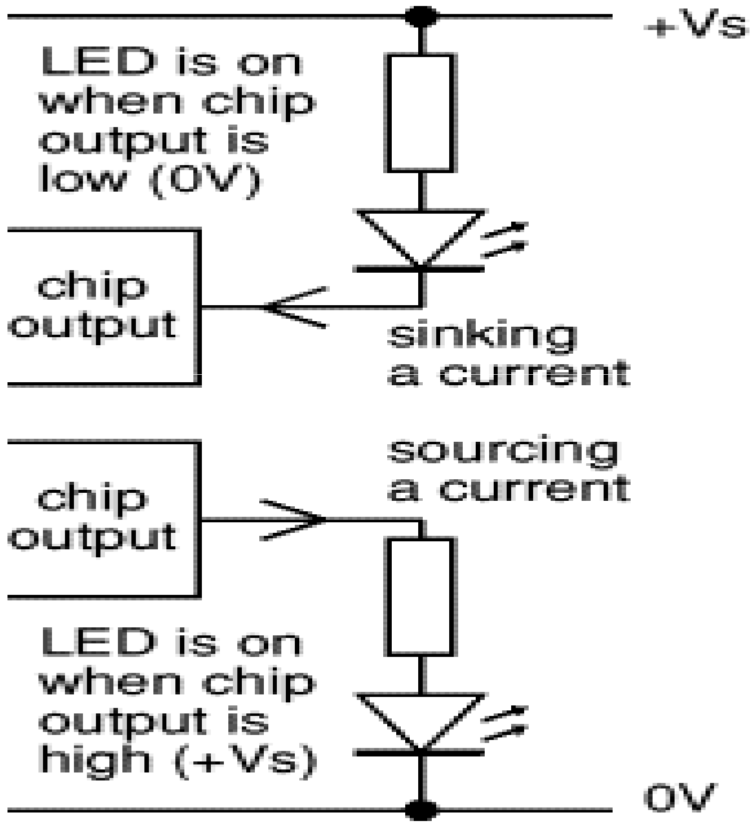
Switches to give logical input





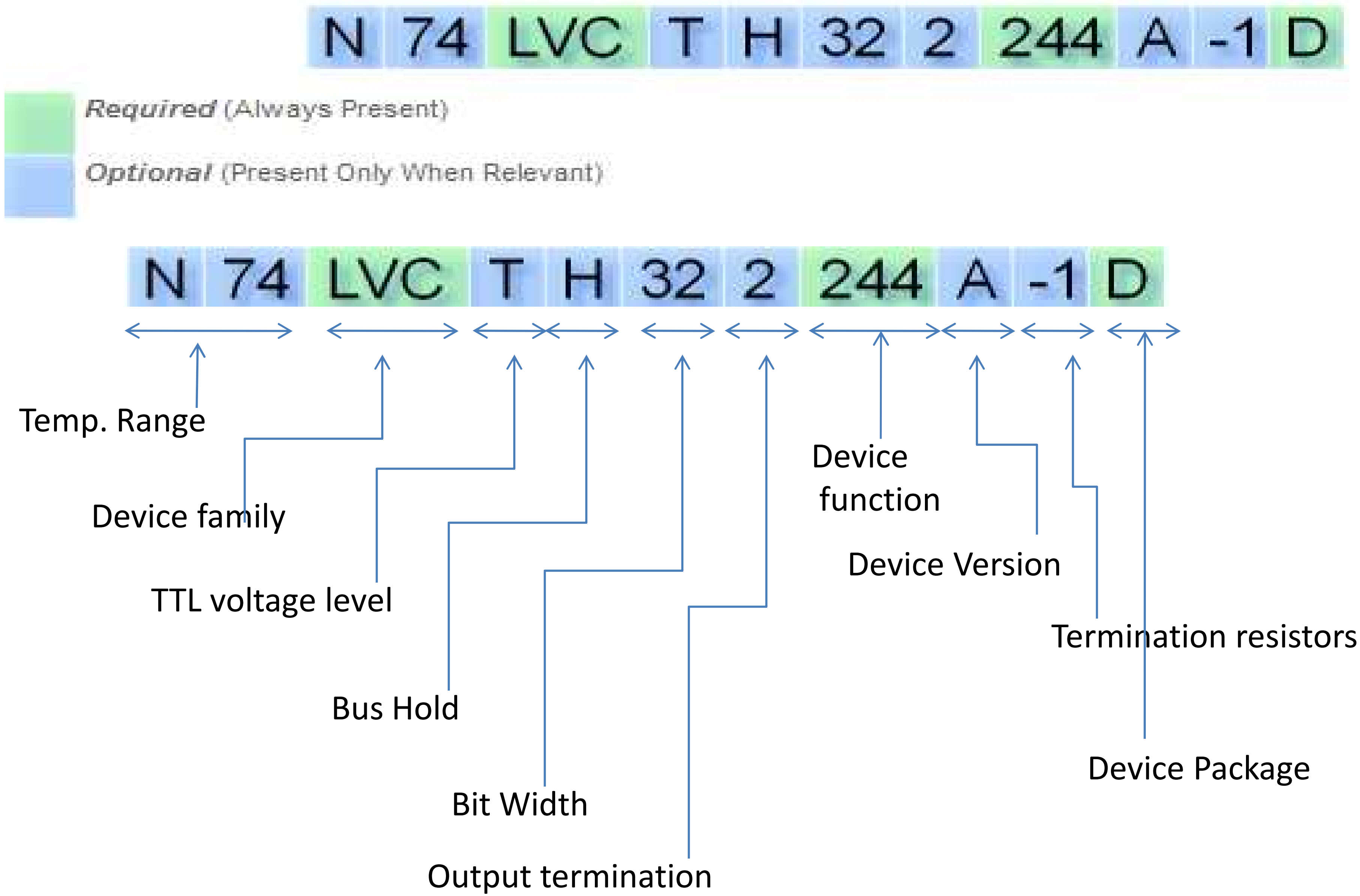
Logical Output with LEDs





- **Always a decoupling capacitor (typically 0.01microF to 0.1 micro F) should be connected in between supply terminal and pin of CMOS IC (4000).**

Nomenclature of ICs



Subfamilies of 74XX series

- **74xx or 74Nxx:** Standard TTL - They have a propagation delay of about 10ns and a power consumption of about 10mW.
- **74Lxx:** Low Power TTL - Power consumption was improved . Reduction in switching speed.
- **74Hxx:** High Speed TTL - Switching speed was improved but increased the power consumption.
- **74Sxx:** Schottky TTL - Improve switching speed and power consumption (2mW) compared to the 74Lxx and 74Hxx types.
- **74LSxx:** Low Power Schottky TTL - Same as 74Sxx with improved power consumption.
- **74ASxx**: Advanced Schottky TTL - Improved design over 74Sxx Schottky to increase switching speed but power consumption increased to about 22mW.
- **74ALSxx:** Advanced Low Power Schottky TTL - Lower power consumption of about 1mW . higher switching speed of about 4nS compared to 74LSxx types.
- **74HCxx:** High Speed CMOS - CMOS technology and transistors to reduce power consumption of less than 1uA with CMOS compatible inputs.
- **74HCTxx:** High Speed CMOS - CMOS technology and transistors to reduce power consumption of less than 1uA but has increased propagation delay of about 16nS due to the TTL compatible inputs.

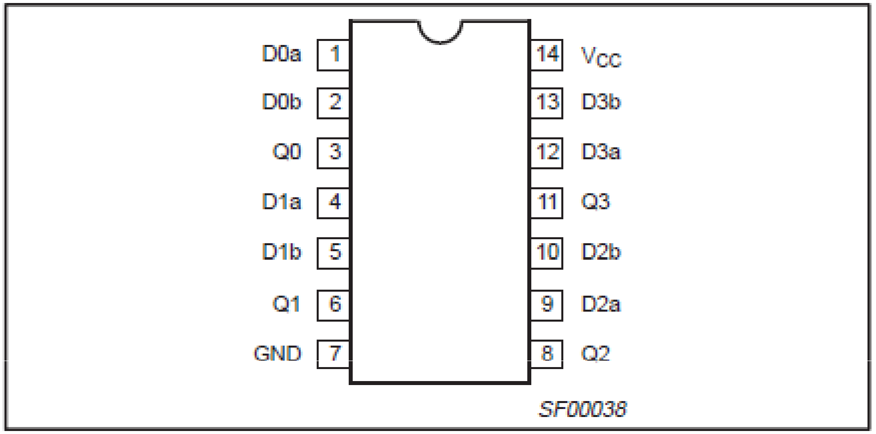
Device functions for Logic gates IC(74XXX)

- ICs for Logic gates:
  - 7408 – Quad 2-input AND
  - 7432 – Quad 2-input OR
  - 7486 – Quad 2-input XOR
  - 7404 Quad 2-input NOT

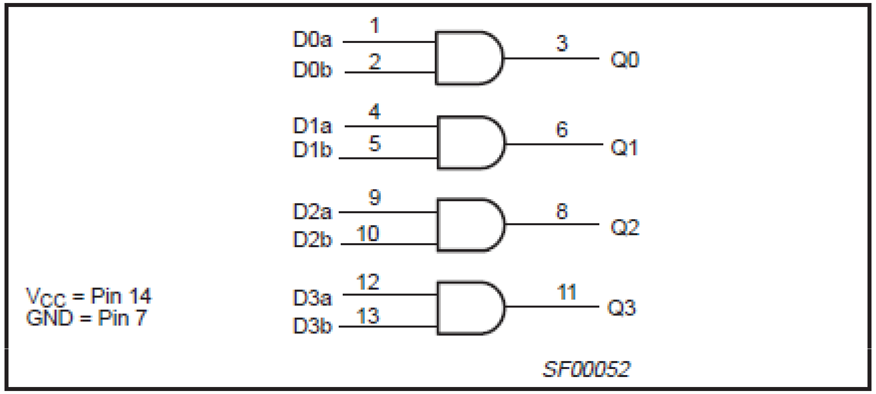
IC 7408

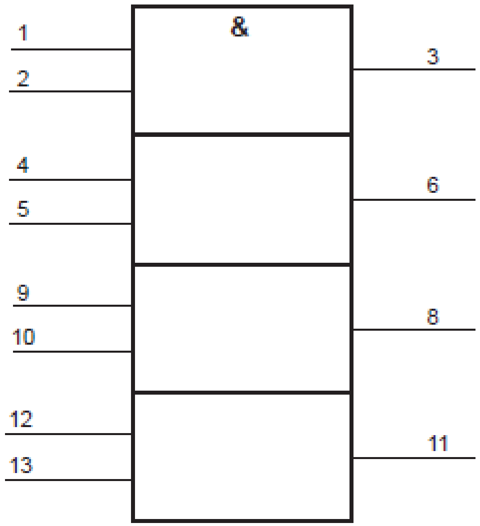
(Quad 2-input AND gates)

PIN CONFIGURATION

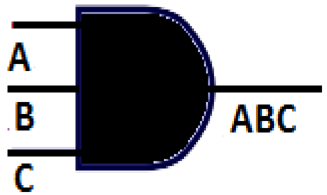


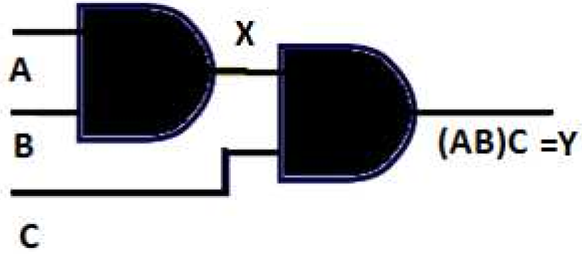
LOGIC DIAGRAM

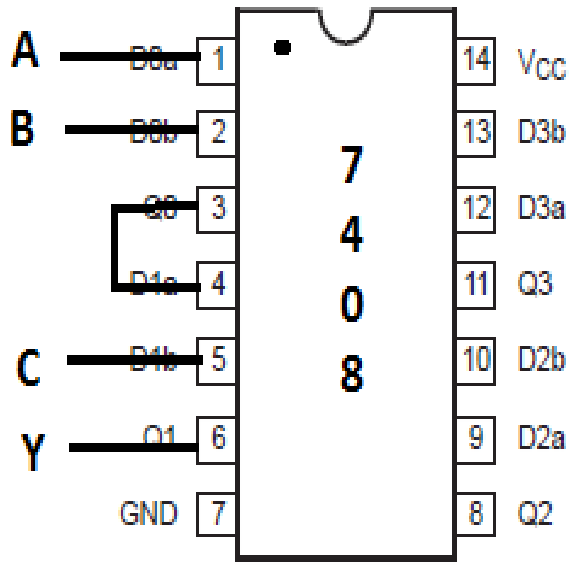




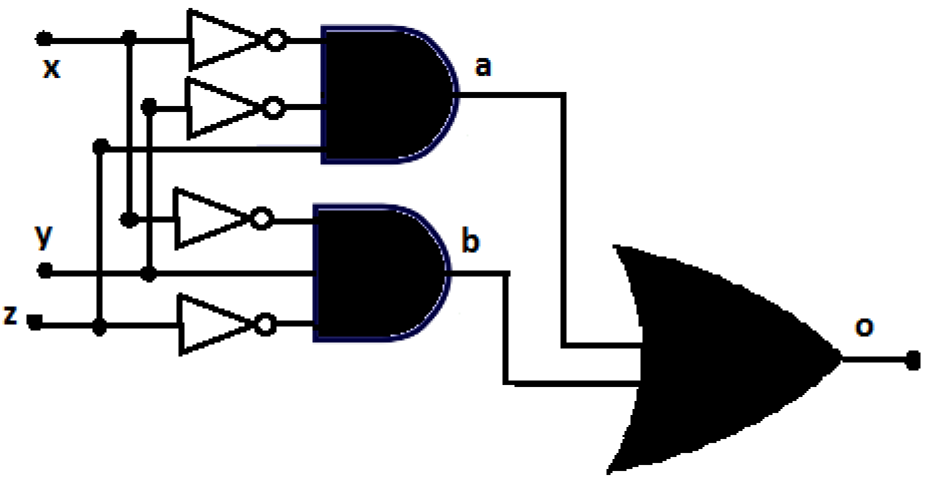
Implementation of logic circuit

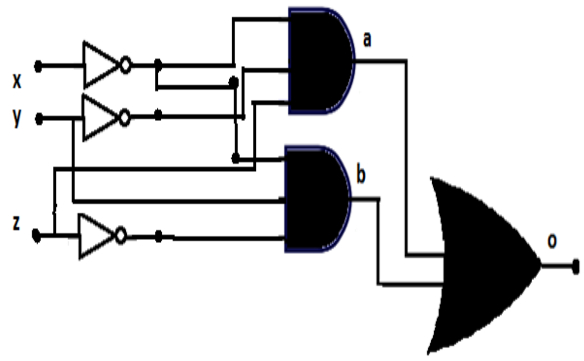






Boolean Expression of a logic circuit





O=x’y’z+x’yz’

x	y	z	a	b	o	Description/Logical expression (Only for o=1)
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

x	y	z	a	b	o	Description/Logical expression (Only for o=1)
0	0	0	0	0	0	
0	0	1	1	0	1	x’y’z
0	1	0	0	1	1	x’yz’
0	1	1	0	0	0	
1	0	0	0	0	0	
1	0	1	0	0	0	
1	1	0	0	0	0	
1	1	1	0	0	0	

Logic Circuit design using Truth Table

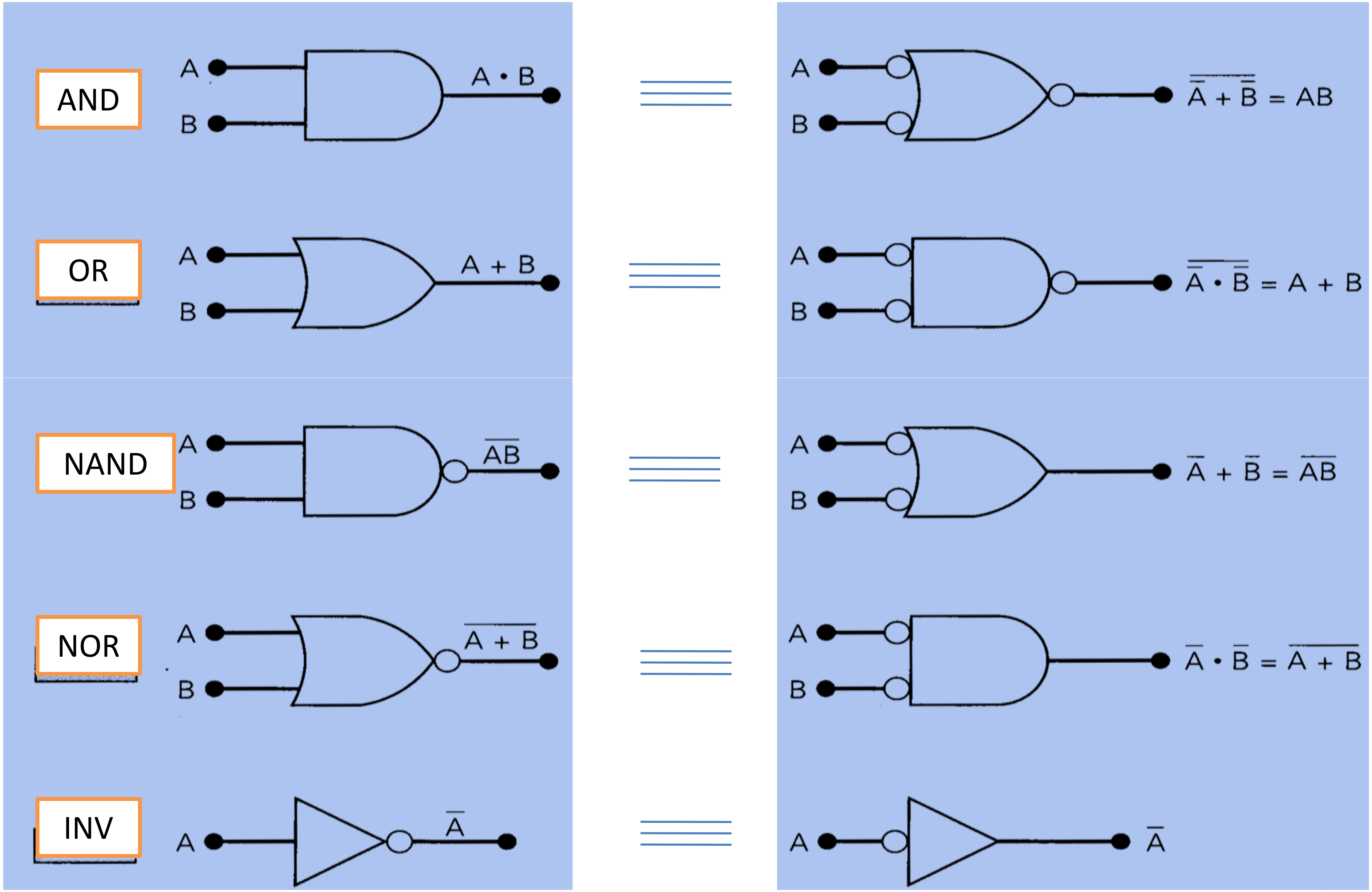
- Design a logical circuit for the function o’ of given truth table

x	y	z	a	b	o	O’	Description/Logical expression (Only for o=1)
0	0	0	0	0	0	1	X’y’z’
0	0	1	1	0	1	0	
0	1	0	0	1	1	0	
0	1	1	0	0	0	1	?
1	0	0	0	0	0	1	?
1	0	1	0	0	0	1	?
1	1	0	0	0	0	1	?
[illegible]	1	1	0	0	0	1	?

Alternate Logic Representation

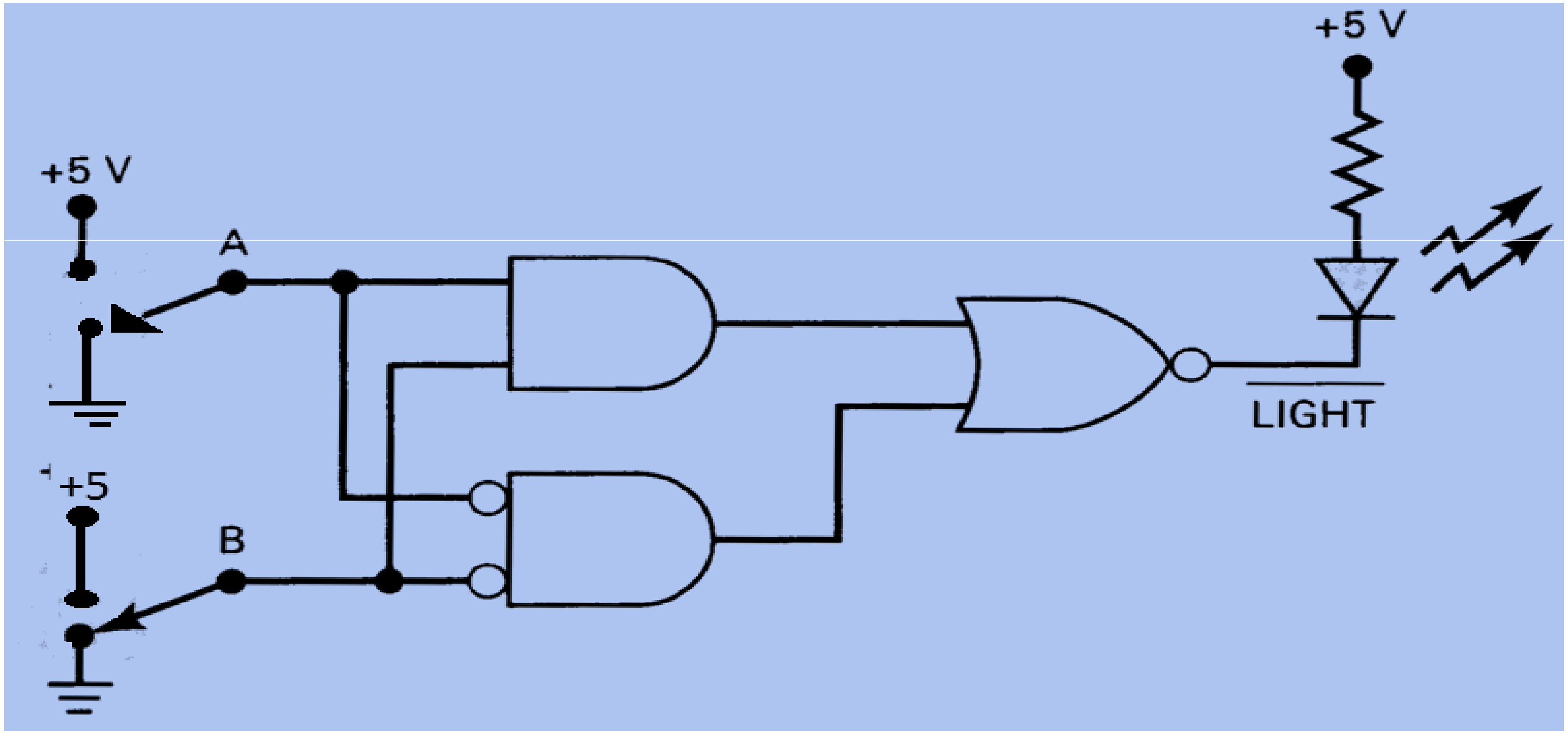
POSITIVE LOGIC

NEGATIVE LOGIC



Problems:- Alternate Logic- Gate representation

b)Obtain the complete truth table for the given circuit, output is LED Glows



Draw the circuit using alternate logic representaion

Problems:- Alternate Logic- Gate representation

a) Obtain the complete truth table for the given circuit