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Reg. #	2019-EE-383
Marks	4.5 18-10-20

Experiment 1

Introduction to Lab Equipment Unitrain and Implementation of Basic Functions

Objective:

- Installation of unitrain interface
- Investigation of the fundamental gates used in digital technology

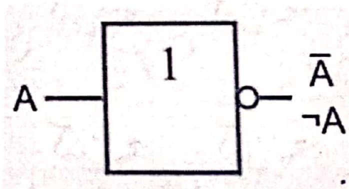
Theory:

Binary *logic* deals with variables that take on two discrete values. The two values the variables may be called by different names *(true* and false, yes and *no*,.etc.), but for our purpose, it is convenient to think in terms of bits and assign the values 1 and 0. The binary logic introduced in this section is equivalent to an algebra called Boolean algebra.

Binary logic consists of binary variables and a set of logical operation. The variables are designated by letters of the alphabet, such as *A*, *B*, C, x, y or i etc., with each variable having two distinct possible values: 1 and 0. There are three basic logical operation: AND, OR and NOT.

NOT (Negation)

The two symbols shown are used to represent the NOT function. According to DIN, the second variation Q=¬A is preferred. The first variation $Q = \bar{A}$ is also permissible. It continues to be used for reasons of clarity.



Exercise 1:

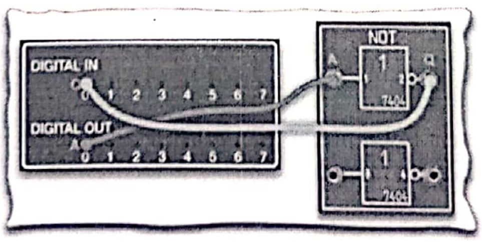


Fig. 1: Experiment set-up - Negation

Notes on the VI:

The Uni*Tr@in*'s outputs are designated $Q_{0..15}$ and its inputs $I_{0..15}$. Uni*Tr@in*'s outputs go to the inputs of the experiment card and the outputs of the experiment card go to Uni*Tr@in*'s inputs. Change the value of Q_0 as suggested and note the response at the output I_0 of the circuit.

[Help available under the menu option: Help → Help topics → Virtual instruments → Standard → Digital → Inputs/outputs]

Q_0	I_0
A	Q = A
0	1
1	0

Exercise 2

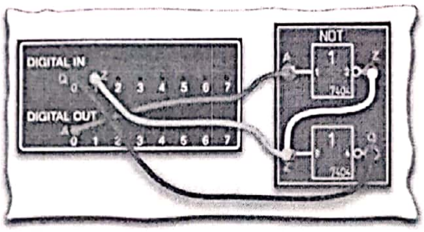


Fig.2: Experiment set-up - Double negation

Q_0	I_1	I_0
A	$Z = \overline{A}$	$Q = \overline{\overline{A}}$
0	1	0
1	0	1

Complete the equations:

$Z = \overline{A}$; $Q = \overline{A} = \overline{\overline{A}} = A$

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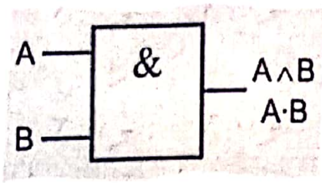
AND

The Boolean AND operation can be written in the forms Q=A^B or Q=A.B. It should be noted that although the Boolean AND function bears certain similarities to algebraic multiplication, there are also distinct differences.



Exercise 3:

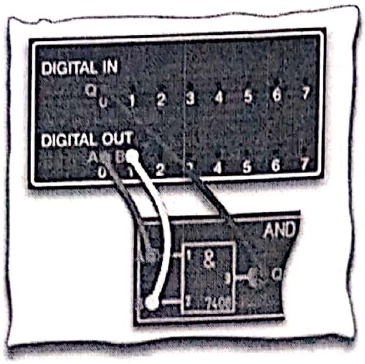
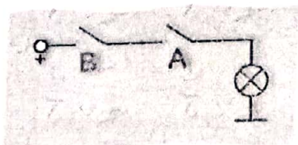


Fig.3: Experiment set-up - AND

Q_1	Q_0	I_0
B	A	Q
0	0	0
0	1	0
1	0	0
1	1	1

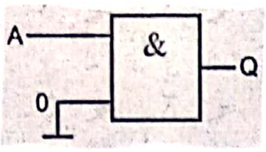


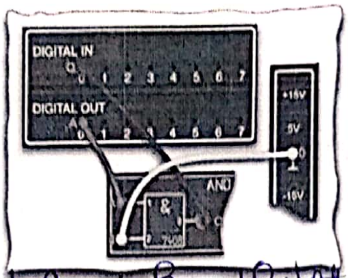
AND operation demonstrated by switches and a lamp

Exercise 4:

Construct the following experiments and note down the results. Describe in a few words the rules that you discover.

a) **ANDing** with "0"



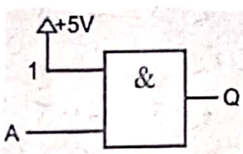


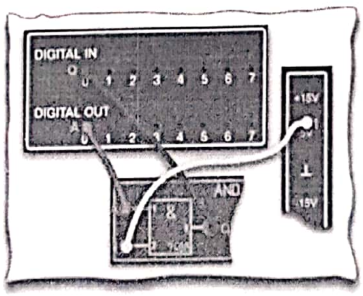
A	B	Output
0	1	0
1	0	0
1	1	1

Result: $A \cdot 0 = 0$

How do you interpret this result? In AND gate, when one input is fixed to zero. then the output will always be zero. Output will be 1 when both inputs are 1.

b) **ANDing** with "1"





Result: $A \cdot 1 =$

How do you interpret this result? It is cleared that when one is fixed to 1 and A is 0, the output is 0. When A is 1, the output is 1.

A	B	Output
0	1	0
1	0	0
1	1	1

0 0 ?

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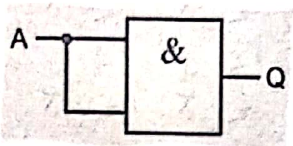
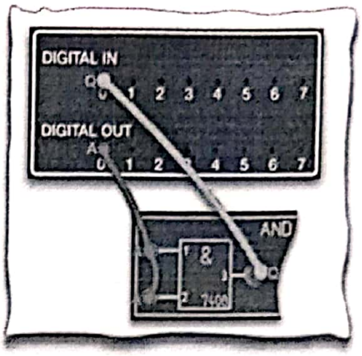
c) **ANDing** A·A (Tautology)

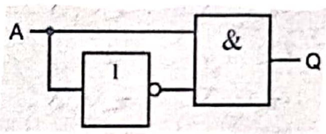


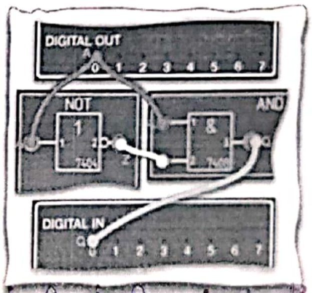


Result: A · A = A or 0, 1.

How do you interpret the result? By using tautology, both terminals have zero input. So, output is zero. Using AND Gate.

d) **ANDing** A·¬A (Negation law)





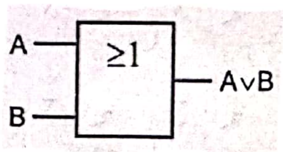
A	B	Output
0	1	0
1	0	0

Result: A · ¬A = 0

How do you interpret the result? In AND gate, when negation law applies. Then output will always be zero. in AND Gate.

OR

The Boolean OR operation is usually written in the forms Q=A+B or Q=A∨B. It should be noted that although the Boolean OR function bears certain similarities to algebraic addition, there are also distinct differences.



Exercise 5:

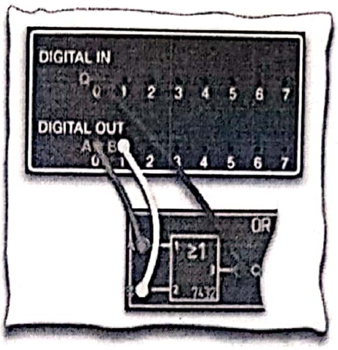
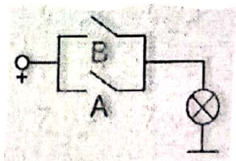


Fig.5 : Experiment set-up - OR

Q_1	Q_0	I_0
B	**A**	**Q**
0	0	0
0	1	1
1	0	1
1	1	1

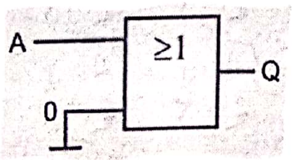


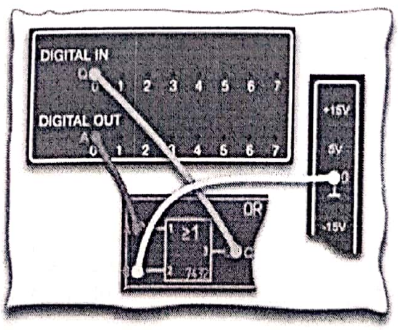
OR operation demonstrated by switches and a lamp

Exercise 6:

Construct the following experiments and note down the results. Describe in a few words the rules that you discover.

a) **ORing** with "0"



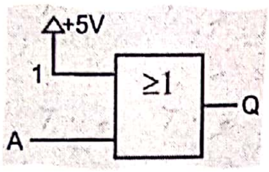


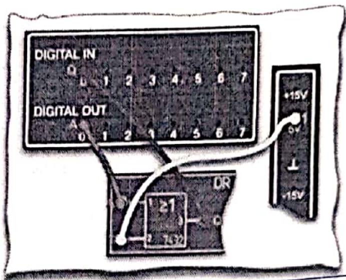
A	B	Output
0	0	0
1	0	1
1	1	1

Result: **A ∨ 0 =** $\boxed{A}$

How do you interpret the results? The input of one terminal is zero and other is grounded. By OR operation, output is zero.

b) ORing with "1"



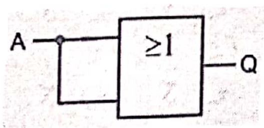


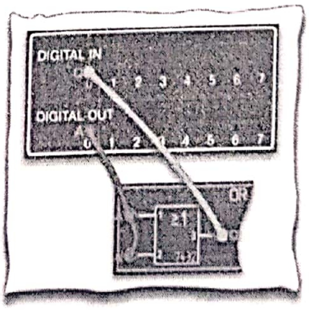
0	1	1
1	1	1

Result: **1 ∨ A =** $\boxed{1}$

How do you interpret the result? In OR gate when one value of input is fix to 1. Then output will always 1. Output will be zero when iputs are zero.

c) ORing A∨A (Tautology)





Result: **A ∨ A =** $\boxed{A}$ or 0, 1.

How do you interpret the result? In tautology, all the value must be true. So, Output will be the value of A or 0, 1.

0	0	0
1	1	1

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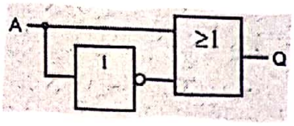
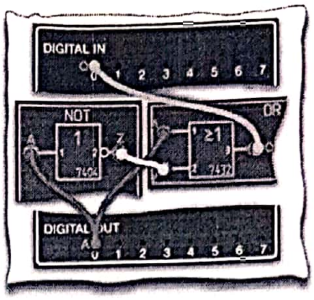
d) ORing A∨¬A (Negation law)





Result: **A** ∨ **¬A =** $\boxed{1}$

How do you interpret the result? In negation law, change the value of one to zero. OR zero to one. So in this circuit value of A is zero & -A is 1. So the output is 1.

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Lab Review:

1. What is the function of a NOT gate?

A NOT gate is a logic gate that inverts the digital input signal. For this reason, a NOT gate is sometimes reffered to as an inverter. A not gate always high input when its input is low, has low output when input is high.

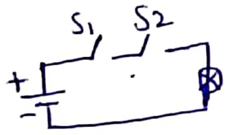
2. Describe the functionality of the OR gate:

The logic OR gate is a type of Digital logic circuit whose output goes HIGH to a logic level 1 only when one or more inputs are HIGH. The output of logic gate is Low when all its inputs are zero.

3. Describe the functionality of the AND gate:

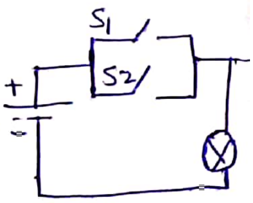
The AND gate is Basic Digital logic gate that implements logic conjuction. A HIGH (1) results only of its all inputs 1. If none inputs are HIGH, LOW(0) occurs.

4. Compare the switch analogy to the actual AND gate:



In AND Gate, both switches are in series. When switches are connected with lamp and battery. When S1 is close and Switch 2 open. Then circuits are not completed and Lamp dont glow. Lamp only glow when both switches are closed.

5. Compare the switch analogy to the actual OR gate:



In OR gate switches are in parallel. When S1 closed and S_2 open then circuit will complete and lamp glow. When S_2 is closed first is open, then circuit will complete. Lamp also glows. Lamp will not glow only when both open.

6. What happens when two negations are performed:

In propositional logic, double negation is the theoram that states; " If a statement is true then it is not the case switch is not open. This is expressed by saying that a proposition A is logically equivalent to not-A. or by the formula $A \cong \sim(\sim A)$, where the sign $\cong$ expresses logical equivalence and the sign $\sim$ expression negation. Hence, double negations will be same as A.

Conclusion:-

In this Lab, we have learnt about different logic gates and operaters with inverter, operations, inverter operations are analyzed in this lab, gates are also analyzed in this lab. We also analyzed the switch analogy of AND or OR Gate. We learnt to design on a software, on Multisim Software.