EXPERIMENT 3

NAME OF EXPERIMENT

TO VERYFY DE MORGAN'S THEOREM IN LAB

THEORY:

DEMORGAN'S THEORY

De Morgan's Theory states two sets of laws or rules which are applicable to Boolean expressions having AND, OR, and NOT logical operations with two inputs (or more). Using these theorems, the logical operation of two variables is negated and converted into another logical operation. Such as, the logical NOR operation on two (or more) variables is equivalent to inversion of these variables and AND'ed together. Similarly, the logical NAND operation on two (or more) variables is equivalent to inversion of these variables and OR'ed, together. In other words, using De Morgan's theorems, the AND operator is replaced with the OR operator, and the OR operator is replaced with the AND operator.

DEMORGAN'S FIRST THEOREM

According to De Morgan's First Theorem, the resultant of two (or more) variables AND'ed and inverted (NOT) as a whole is equivalent to the OR of the complements of individual variables. Thus, AND + NOT (NAND) operation on variables is equivalent to the sum (OR) of the individual complement of each variable. In Boolean expression, it is stated as follow:

$$(A.B)' = A' + B'$$

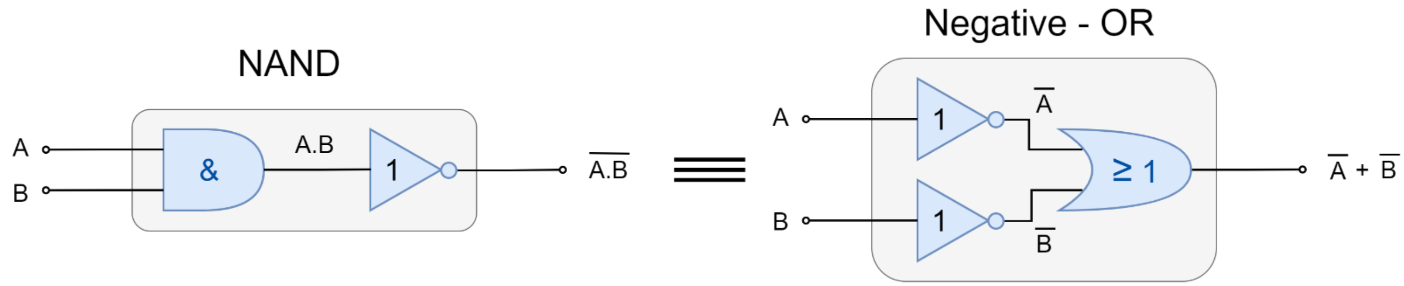
VERIFICATION OF DEMORGAN'S FIRST THEOREM USING TRUTH TABLE

De Morgan's First Theorem can be verified using a truth table as illustrated below:

De-Morgan's First Theorem Verification						
A	B	A. B	$\overline{A.B}$	$\overline{A}$	$\overline{B}$	$\overline{A+B}$
0	0	0	1	1	1	1
0	1	0	1	1	0	1
1	0	0	1	0	1	1
1	1	1	0	0	0	0

DEMORGAN'S FIRST LAW IMPLEMENTATION

The following figure shows the implementation of De Morgan's First Theorem. The two logic circuits are equivalent to each other as per De Morgan's First Theorem.



The left logic circuit forms a NAND (AND + NOT) gate. Whereas the right logic circuit, first inverts the inputs then they are OR'ed. These two logic circuits are equivalent to each other i.e. NAND = negative-OR. It can also be stated that a complement can be shifted from the output of the AND gate to the individual input of an OR gate and will be identical in logic operation as per the first theorem of De Morgan.

DEMORGAN'S SECOND THEOREM

According to De Morgan's Second Theorem, the resultant of two (or more) variables OR'ed and inverted (NOT) as a whole is equivalent to the AND of the complements of individual variables. Thus, OR + NOT (NOR) operation on variables is equivalent to AND of the individual complement of each variable. In Boolean expression, it is stated as follow:

$$(A + B)' = A'.B'$$

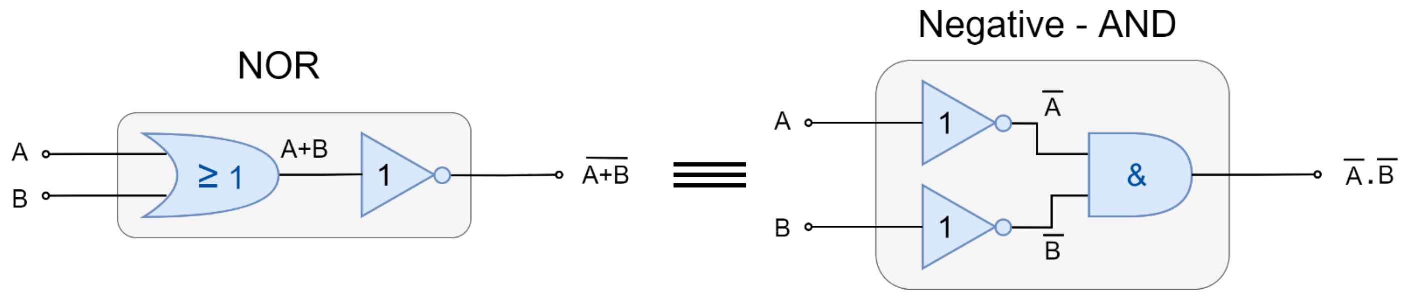
VERIFICATION OF DEMORGAN'S SECOND THEOREM USING TRUTH TABLE

De Morgan's Second Theorem can be verified using a truth table as illustrated below:

De-Morgan's Second Theorem Verification						
A	B	$A + B$	$\overline{A + B}$	$\overline{A}$	$\overline{B}$	$\overline{A.B}$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

DEMORGAN'S SECOND LAW IMPLEMENTATION

The following figure shows an implementation of De Morgan's Second Theorem. The two logic circuits are equivalent to each other as per De Morgan's Second Theorem.



The left logic circuit forms a NOR (OR + NOT) gate. Whereas the right logic circuit, first inverts the inputs then they are AND'ed. These two logic circuits are equivalent to each other i.e. NOR = negative-AND. It can also be stated that a complement can be shifted from the output of OR gate to individual input of an AND gate and will be identical in logic operation as per the second theorem of De Morgan. Thus, according to De Morgan, an AND operation on inverted inputs is equivalent to NOR (OR + NOT) operation and vice versa. Similarly, an OR operation on inverted inputs is equivalent to NAND (AND + NOT) operation and vice versa. In the above text, De Morgan's theorems have been applied to two-input variables. However, theorems are equally valid for more than two inputs variables.

CONCLUSION

Hence from truth table, we can verify the De Morgan's first and second theorem in lab.