

Chapter 4

BOOLEAN ALGEBRA AND THEOREMS, MINI TERMS AND MAX TERMS

Lesson 3

DeMorgan Theorems

First DeMorgan Theorem

NOR is replaceable by NAND if OR operation is replaced by AND and each input and output at the gate is complemented at another

$$\overline{A1 + A2} = \overline{A1} \cdot \overline{A2}$$

Second DeMorgan Theorem

NAND is replaceable by NOR if AND operation is replaced by OR and each input and output at the gate is complement at another

$$\overline{A1.A2} = \overline{A1} + \overline{A2}$$

DeMorgan Theorem

- First DeMorgan theorem states, complement of two or more variables and then AND operation on these is equivalent to NOR operation on these variables [NOR means complement after two or more variables Ored].

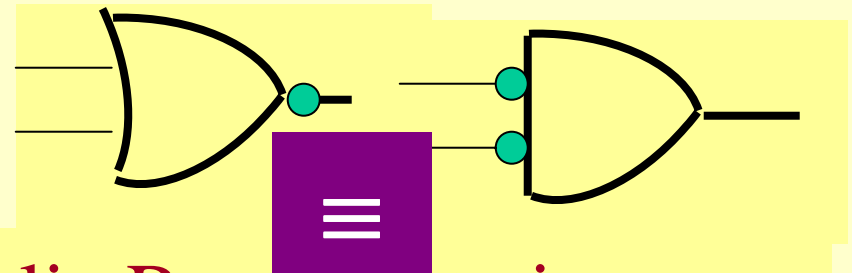
DeMorgan Theorem

Second DeMorgan theorem states that complement of two or more variables and then OR operation on these is equivalent to NAND operation on these variables [NAND means complement after two or more variables ANDed].

First DeMorgan Theorem

Inputs		Output
A1	A2	F
0	0	1
0	1	0
1	0	0
1	1	0

$$F = \overline{A1 + A2} = \overline{A1} . \overline{A2}$$

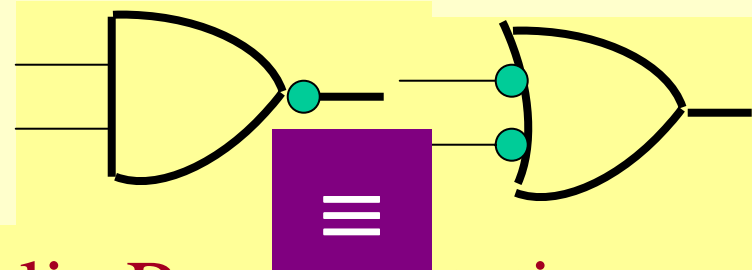


Symbolic Representation

Second DeMorgan Theorem

Inputs		Output
A1	A2	Y
0	0	1
0	1	1
1	0	1
1	1	0

$$F = \overline{A1} \cdot \overline{A2} = \overline{A1 + A2}$$



Symbolic Representation

Application

- **Simplifications of Boolean Algebraic Equations**

Application of DeMorgan Theorem

1. 1 Complement of each term on right hand side, then
2. 2 Convert the dot (AND) operation to + (OR) operation or + (OR) operation to dot (AND) operation, dot sign to + sign and then
3. 3 Complement the remaining expression as a whole;

we get the left hand side.

Application of DeMorgan Theorem

1. We can put bar over the entire expression, by complementing each variable under it and then changing sign if $+$ to dot and if dot then to $+$.

Example

$$1. \overline{C} + D + \overline{E} =$$

$$1. C + \overline{D} + E \text{ Step 1: Complementation}$$

$$1. C \cdot \overline{D} \cdot E \text{ Step 2 : } + \longrightarrow \cdot$$

$$1. \overline{C \cdot \overline{D} \cdot E} \text{ Step 3 : All complement}$$

Application of DeMorgan Theorem

1. We can remove bar over the entire expression, by complementing each variable under it and then changing sign if $+$ to dot and if dot then to $+$.

Example

$$1. \overline{C} . D . \overline{E} =$$

$$1. C . \overline{D} . E \text{ Step 1: Complementation}$$

$$1. C + \overline{D} + E \text{ Step 2 : } \longrightarrow +$$

$$1. \overline{C + \overline{D} + E} \text{ Step 3 : All complement}$$

Summary

DeMorgan theorems states that the NAND and NOR are replaceable with each other when if AND is replaced by OR and each input and output at one is complement at another

End of Lesson 3

DeMorgan Theorems

THANK YOU