Digital electronics

Lecture - 3

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de Morgan´s Theorem – There are two “de Morgan´s” rules or theorems,

Theorem 1 : The complement of two or more variables is equal to the product of the complements of the variables .

This can be written as :

Two separate terms NOR´ed together is the same as the two terms

inverted(Complement) and AND´ed for example:

$$\overline{A + B} = \bar{A} .\bar{B}$$

Theorem 2 : The complement of the product of two or more variables is equal to the sum of the complements of the variables .

This can be written as :

Two separate terms NAND´ed together is the same as the two terms inverted (Complement) and OR´ed for example:

$$\overline{A.B} = \bar{A} + \bar{B}$$

These two theorems are proved as below.

To prove $\overline{A+B} = \bar{A}.\bar{B}$

Since each variable can have a value either 0 or 1 , the following four cases arise :

(1) when A = 0 , B = 0 , $\overline{A+B} = \overline{0+0} = \bar{0} = 1$

and $\bar{A}.\bar{B} = \bar{0}.\bar{0} = 1.1 = 1$

Hence $\overline{A+B} = \bar{A}.\bar{B}$

(2) when A = 0 , B = 1 , $\overline{A+B} = \overline{0+1} = \bar{1} = 0$,

and $\bar{A}\,.\bar{B} = \bar{0}\,.\bar{1} = 1.0 = 0$

Hence $\overline{A+B} = \bar{A}\,.\bar{B}$

(3) when A = 1 , B = 0 , $\overline{A+B} = \overline{1+0} = \bar{1} = 0$,

and $\bar{A}\,.\bar{B} = \bar{1}\,.\bar{0} = 0.1 = 0$

Hence $\overline{A+B} = \bar{A}\,.\bar{B}$

(4) when A = 1 , B = 1 , $\overline{A+B}$ = $\overline{1+1}$ = $\bar{1}$ = 0 ,

and $\bar{A} \, . \bar{B}$ = $\bar{1} \, . \bar{1}$ = 0.0 = 0

Hence $\overline{A+B}$ = $\bar{A} \, . \bar{B}$

Since in every case L.H.S equals to R.H.S , This theorem is proved .