

## Basic Identities of Boolean Algebra

- |     |                           |     |                                   |     |                        |     |                               |
|-----|---------------------------|-----|-----------------------------------|-----|------------------------|-----|-------------------------------|
| 1.  | $X + 0$                   | $=$ | $X$                               | 2.  | $X \cdot 1$            | $=$ | $X$                           |
| 3.  | $X + 1$                   | $=$ | $1$                               | 4.  | $X \cdot 0$            | $=$ | $0$                           |
| 5.  | $X + X$                   | $=$ | $X$                               | 6.  | $X \cdot X$            | $=$ | $X$                           |
| 7.  | $X + \overline{X}$        | $=$ | $1$                               | 8.  | $X \cdot \overline{X}$ | $=$ | $0$                           |
| 9.  | $\overline{\overline{X}}$ | $=$ | $X$                               |     |                        |     |                               |
| 10. | $X + Y$                   | $=$ | $Y + X$                           | 11. | $XY$                   | $=$ | $YX$                          |
| 12. | $X + (Y + Z)$             | $=$ | $(X + Y) + Z$                     | 13. | $X(YZ)$                | $=$ | $(XY)Z$                       |
| 14. | $X(Y + Z)$                | $=$ | $XY + XZ$                         | 15. | $X + YZ$               | $=$ | $(X + Y)(X + Z)$              |
| 16. | $\overline{X + Y}$        | $=$ | $\overline{X} \cdot \overline{Y}$ | 17. | $\overline{X \cdot Y}$ | $=$ | $\overline{X} + \overline{Y}$ |

Note: 10-11 are referred to as commutative laws  
12-13 are referred to as associative laws  
14-15 are referred to as distributive laws  
16-17 are referred to as DeMorgan's theorem

## Consensus Theorem

$$XY + \overline{X}Z + YZ = XY + \overline{X}Z$$

(dual)  $(X + Y)(\overline{X} + Z)(Y + Z) = (X + Y)(\overline{X} + Z)$

**Minterm:** a product term in which all the variables appear exactly once, either complemented or uncomplemented; represents exactly one combination of the binary variables in a truth table (a function, not equal to 0, having the minimum number of 1's in its truth table).

**Maxterm:** a sum term that contains all the variables in complemented or uncomplemented form (a function, not equal to 1, having the maximum of 1's in its truth table).

## Properties of minterms

1. There are  $2^n$  minterms for  $n$  Boolean variables. These minterms can be evaluated from the binary numbers from 0 to  $2^n - 1$ .
2. Any Boolean function can be expressed as a logical sum of minterms.
3. The complement of a function contains those minterms not included in the original function.
4. A function that includes all the  $2^n$  minterms is equal to logic 1.