

# Chapter 2: Boolean Algebra & Logic Gates

## Outline

- Boolean Algebra.
- Simplifying logic circuits.
- Binary Variable.
- Logical operator.
  - AND (.), OR (+), NOT ( ' ), XOR.
  - NAND, NOR, XNOR.
- Truth Tables.
- The dual of a boolean expression.
- The duality principle.
- Axioms and Theorems of Boolean Algebra.
- Logic Gate Symbols.
- Variable vs Literal vs Term.
- **Product Term vs Sum Term.**
- **Complement** of a function.
- Standard Forms:
  - **Sum of Products (SOP).**
  - **Product of Sums (POS).**
- **Minterm** = Standard Product.
- **Maxterm** = Standard Sum.
- **Canonical Forms:**
  - **Sum of Minterms.**
  - **Product of Maxterms.**
- Get the **Boolean expression** from the **truth table**.
- Drawing the **logic diagram** of the circuit.
- Drawing using **NAND** and **NOR**.

## *Simplifying logic circuits*

By reducing the number of terms, the number of literals, or both in a Boolean expression.

## A general conversion procedure:

To convert from one canonical form to another, interchange the symbols  $\sum$  and  $\prod$  and list those numbers missing from the original form.

## Important Notes:

- The maxterm with subscript  $j$  is a complement of the minterm with the same subscript  $j$  and vice versa.

$$i.e. \quad M_j = m'_j$$

- The **complement** of a function expressed as the **sum of minterms** equals the sum of minterms missing from the original function.
- The implementation of Boolean functions with **NAND** gates requires that the functions be in **sum-of-products** form.
- The total number of minterms or maxterms for a boolean functions is  $2^n$  where n is the number of binary variables.