Experiment No.: 02

Name of the experiment: Verification of De Morgan’s Theorem

Objective:

1. To verify **De Morgan’s Theorem** using logic gates.

i) (A⋅B)′=A′+B′

ii) (A+B)′=A′⋅B′

1. To understand and demonstrate the relationship between the logic operations AND, OR, and NOT using these identities.

**Theory**:

De Morgan’s Theorems are fundamental in Boolean algebra and digital logic. They describe the equivalence between logical AND and OR operations when inverted:

1. **First Theorem**:  
   (A⋅B)′=A′+B′  
   This theorem states that the complement of an AND operation between two variables is equivalent to the OR operation between the complements of the two variables.

**[ Add image here]**

1. **Second Theorem**:  
   (A+B)′=A′⋅B′  
   This theorem states that the complement of an OR operation between two variables is equivalent to the AND operation between the complements of the two variables.

**[ Add image here ]**

These theorems are particularly useful in simplifying complex Boolean expressions and help in designing efficient digital circuits.

### **Truth Table for De Morgan’s Theorem:**

| **A** | **B** | **(A⋅B)′** | **A′+B′** | **(A+B)′** | **A′⋅B′** |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 |

From the truth table, it is evident that:

* (A⋅B)′ and A′+B′ have the same output.
* (A+B)′ and A′⋅B′ have the same output.

## **Apparatus:**

1. Logic gate ICs:
   * AND gate (IC 7408)
   * OR gate (IC 7432)
   * NOT gate (IC 7404)
2. Breadboard
3. Connecting wires
4. Power supply (5V DC)

## **Procedure:**

1. **Circuit Setup**:
   * Set up the circuit to verify the first theorem, (A⋅B)′=A′+B′, using AND, OR, and NOT gates.
   * Connect two inputs, A and B, to an AND gate to get A⋅B, then connect the output of the AND gate to a NOT gate to obtain (A⋅B)′.
   * Connect inputs A and B to individual NOT gates to get A′ and B′′, and then feed the outputs to an OR gate to obtain A′+B′.
   * Compare the outputs of (A⋅B)′ and A′+B′.
2. **Verifying the Second Theorem**:
   * Set up the circuit for the second theorem, (A+B)′=A′⋅B′.
   * Connect inputs A and B to an OR gate to get A+B, then connect the output of the OR gate to a NOT gate to get (A+B)′.
   * Use NOT gates to get A′′ and B′ from inputs A and B, and then connect the outputs to an AND gate to get A′⋅B′.
   * Compare the outputs of (A+B)′ and A′⋅B′.
3. **Testing and Verifying the Results**:
   * Apply various combinations of logic levels (0 or 1) to the inputs A and B.
   * For each combination of inputs, record the output values for both theorems and verify that the outputs match the expected results from the truth table.

Discussion: **[ Write your own ]**