

1. A company uses a digital **safe access control system** built using logic gates.

There are **three conditions (inputs)**:

A → Employee has entered the correct **PIN** (1 = correct, 0 = wrong)

B → Employee **ID** card is detected (1 = detected, 0 = not detected)

C → Security override key is active (1 = active, 0 = inactive)

The **safe door should open** (Output = 1) **only when**:

The correct **PIN** **and** ID card are both **valid**, **or**

The **security override key** is active **but** no wrong PIN attempt is made (i.e., PIN input = 0 doesn't cause override opening).

1. Write the Boolean expression for the system.
2. Simplify it using Boolean laws.
3. Draw the logic diagram using basic gates (AND, OR, NOT).
4. Create a truth table.
5. Explain one situation where the logic might **fail or be tricked** if an input sensor is faulty.

2. Convert $(111011.101)_2$ to decimal.

Convert $(126)_{10}$ to binary, then from that binary to hexadecimal.

3. Simplify the boolean Expressions:

1. $A + B' \cdot (A' + B)$

2. $A \cdot B + A \cdot C + B \cdot C$