01. Truth Table for the Staircase Bulb Switches:

Let's use the following notation:
- Switch 1 (Ground Floor) is represented by S1.
- Switch 2 (First Floor) is represented by S2.
- Bulb ON is represented by 1.
- Bulb OFF is represented by 0.

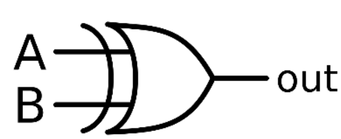
The truth table is as follows:

S1	S2	Bulb Status
0	0	0
0	1	1
1	0	1
1	1	0

Explanation:
- When both switches (S1 and S2) are OFF (0), the bulb remains OFF (0).
- When only Switch 2 (S2) is ON (1), the bulb turns ON (1).
- When only Switch 1 (S1) is ON (1), the bulb turns ON (1).
- When both switches (S1 and S2) are ON (1), the bulb turns OFF (0).

b. Logic Circuit/Gate for the Staircase Bulb Switches:

The most suitable logic circuit to achieve this functionality is an XOR gate. The XOR gate produces an output of 1 when the number of inputs that are 1 is odd. It can be represented using the following symbol:



In this circuit:
- S1 and S2 are the two switches.
- The output of the XOR gate is connected to the bulb.
- When either S1 or S2 (but not both) is ON, the XOR gate will produce an output of 1, turning the bulb ON.
- When both switches are either ON or OFF, the XOR gate will produce an output of 0, turning the bulb OFF.

02. NAND Gate realization of Boolean function Y = AB + CD:

a. Extracting the Boolean function using NAND gates:

The NAND gate is a universal gate, meaning that any logical function can be implemented using only NAND gates. To realize the Boolean function Y = AB + CD using NAND gates, we can follow these steps:

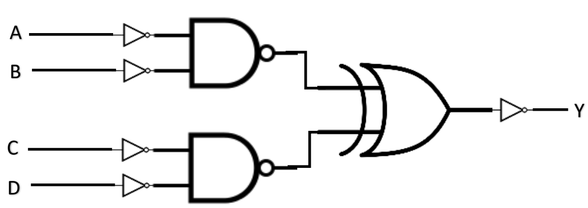
1. Apply De Morgan's theorem to get the NAND equivalent of the OR operation:
   Y = AB + CD
   Y = (AB)'(CD)' (Using De Morgan's theorem)

2. Apply De Morgan's theorem again to get the NAND equivalent of the AND operation:
   Y = (AB)'(CD)'
   Y = (A' + B')(C' + D') (Using De Morgan's theorem)

3. Finally, apply De Morgan's theorem one more time to get the final expression in terms of NAND gates:
   Y = ((A' + B') NAND (C' + D'))'

b. Drawing the logic circuit for the extracted Boolean function:

The logic circuit for the extracted Boolean function Y = ((A' + B') NAND (C' + D'))' is as follows:



In this circuit:
- A, B, C, and D are the input variables.
- The NAND gates are represented by the NAND symbol.
- The output of each NAND gate is fed into another NAND gate, and the final output Y is inverted using a NOT gate to get the desired Y = AB + CD.

2.

A⊕B . (B⊕C)'. C