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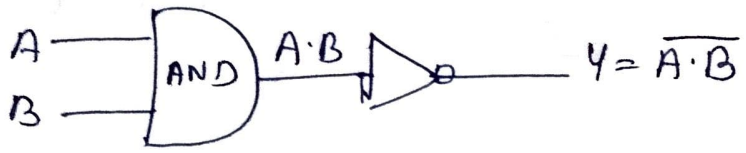
Ans 1. NAND gate is AND Gate succeeded by NOT gate. A NAND gate constitutes one or more inputs with single output. NAND gate has an output that is normally at logic high and only goes to logic low when all its inputs are at logic high.

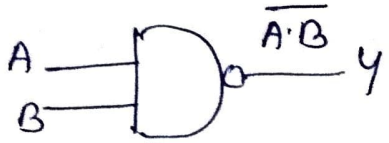
The Boolean Expression for NAND Gate $\Rightarrow (A \cdot B)' = Y$

2 Input NAND Gate

In this NAND gate there are only two input values and an output value.

Logic Design –



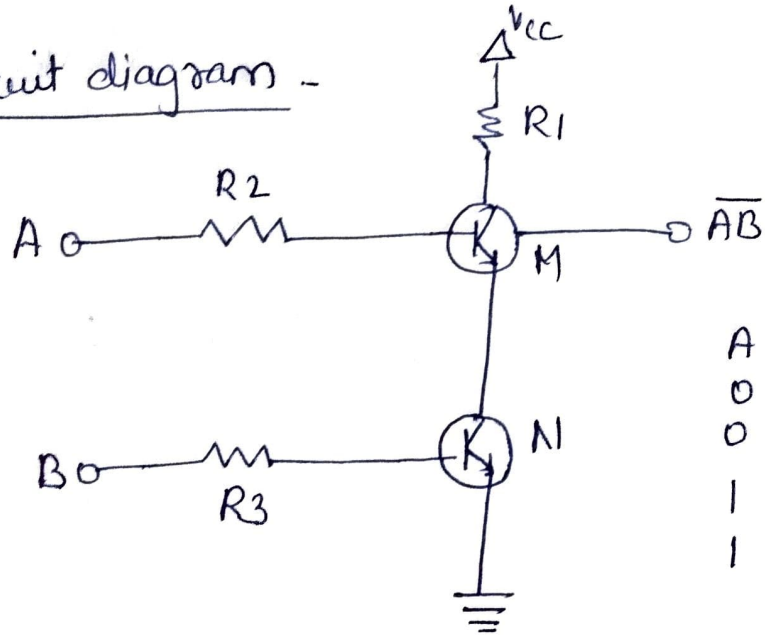



Truth-table –

| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

When value of A and B is 0 then $A \cdot B = 0$ and $\overline{A \cdot B} = 1$
When value of A is 0 and B is 1 then $A \cdot B = 0$ and $\overline{A \cdot B} = 1$
When value of A is 1 and B is 0 then $A \cdot B = 0$ and $\overline{A \cdot B} = 1$
When value of A is 1 and B is 1 then $A \cdot B = 1$ and $\overline{A \cdot B} = 0$

Circuit diagram –

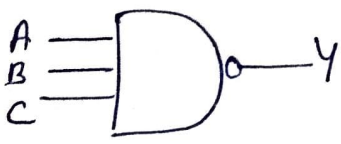



| A | B | M | N | Output |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 |

## 3 Input NAND Gate

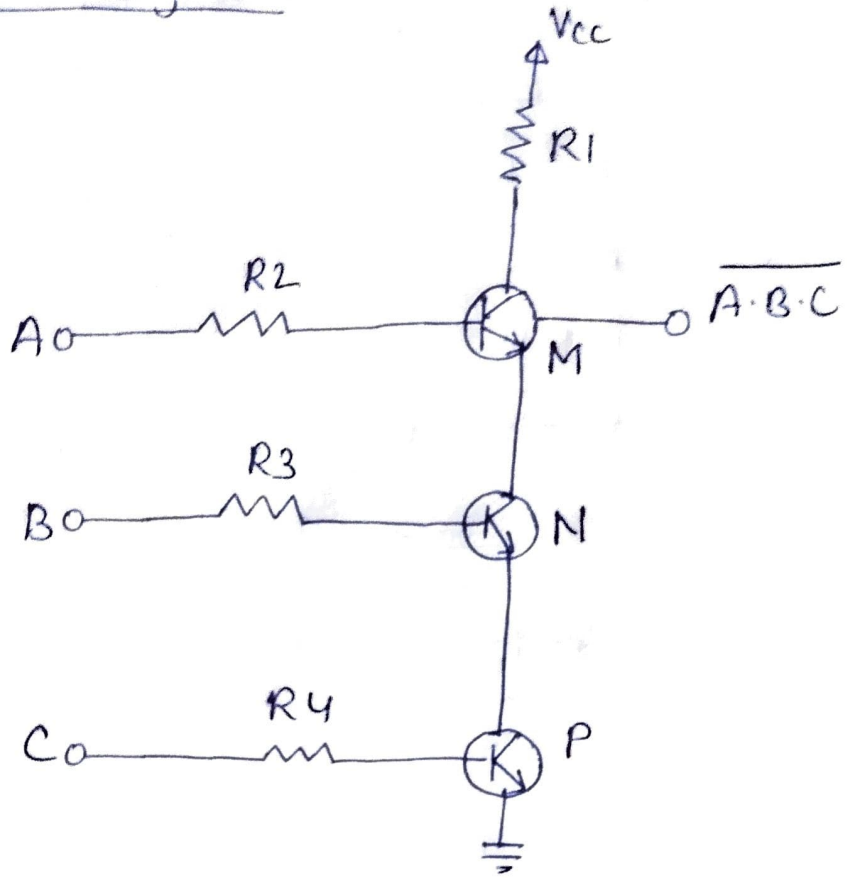
3 Input NAND Gate has 3 inputs and 1 output

Logic Design –



Boolean Expression → $(A \cdot B \cdot C)' = Y$

Circuit diagram -




Truth Table -

| A | B | C | M | N | P | Output |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 |

When value of A, B, C is 0 then $A \cdot B \cdot C = 0$ and $\overline{A \cdot B \cdot C} = 1$

When value of A = 0, B = 0 and C = 1 $A \cdot B \cdot C = 0$ and $\overline{A \cdot B \cdot C} = 1$

When value of A = 0, B = 1, C = 0 $\rightarrow A \cdot B \cdot C = 0 \rightarrow \overline{A \cdot B \cdot C} = 1$

A = 0 B = 1 C = 1 $A \cdot B \cdot C = 0$ $\overline{A \cdot B \cdot C} = 1$

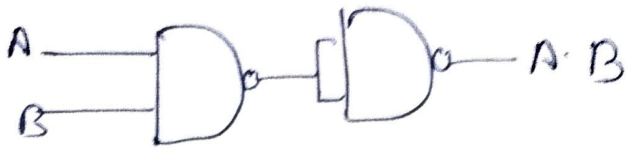
A = 1 B = 0 C = 0 $A \cdot B \cdot C = 0$ $\overline{A \cdot B \cdot C} = 1$

A = 1 B = 0 C = 1 $A \cdot B \cdot C = 0$ $\overline{A \cdot B \cdot C} = 1$

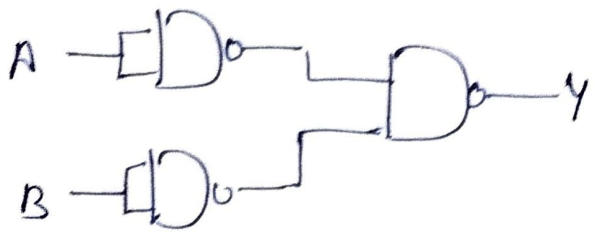
A = 1 B = 1 C = 0 $A \cdot B \cdot C = 0$ $\overline{A \cdot B \cdot C} = 1$

A = 1 B = 1 C = 1 $A \cdot B \cdot C = 1$ $\overline{A \cdot B \cdot C} = 0$

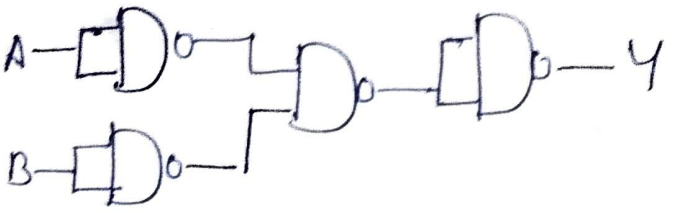
AND using NAND



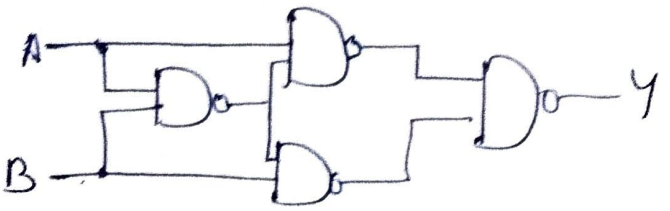

OR using NAND




NOR using NAND




EX-OR using NAND




EX-NOR using NAND