# ASSIGNMENT 5

[Design of a combinational logic circuit for **3-BIT COMPARATOR** using 2 input NAND GATES]


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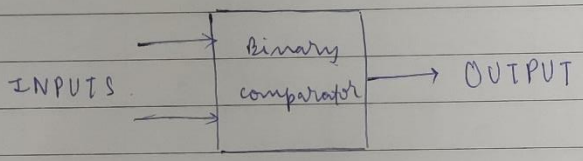
**Objective:-** To implement a comparator circuit for two 3-bit numbers using only 2-input NAND gates.

**Theory:-** Comparator is a combinational logic circuit that compares the magnitude of two binary quantities to determine which one has the greater magnitude. In other words, a comparator determines the relationship of two binary quantities.




**Working:-** Let the two 3-bit nos. be A and B.

$A \rightarrow A_2 A_1 A_0$ and $B \rightarrow B_2 B_1 B_0$.

where $A_2$ and $B_2$ are MSB whereas $A_0$ and $B_0$ are LSB of A and B respectively.

**Notations:-**

E → $A = B$

G → $A > B$

L → $A < B$

**Conditions:-**

For $A > B$: $A_2 > B_2$, or.

$A_2 = B_2$ and $A_1 > B_1$, or

$A_2 = B_2$ and $A_1 = B_1$ and $A_0 > B_0$.

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For $A = B$, $A_2 = B_2$ and $A_1 = B_1$ and $A_0 = B_0$.

For $A < B$, $A_2 < B_2$ or.
$A_2 = B_2$ and $A_1 < B_1$ or
$A_2 = B_2$ and $A_1 = B_1$ and $A_0 < B_0$.

Truth Table:-

| $A_2$ | $A_1$ | $A_0$ | $B_2$ | $B_1$ | $B_0$ | $A<B$ | $A=B$ | $A>B$ |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . | . |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |

Expression:-

$$L = (A < B) = A_2' B_2 + (A_2 B_2 + A_2' B_2')(A_1' B_1) + (A_2 B_2 + A_2' B_2')(A_1 B_1 + A_1' B_1') A_0' B_0$$

$$E = (A = B) = (A_0 B_0 + A_0' B_0')(A_1 B_1 + A_1' B_1')(A_2 B_2 + A_2 B_2')$$

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$G_1 = (A > B) = A_2 B_2' + (A_2 B_2 + A_2' B_2') A_1 B_1' + (A_2 B_2 + A_2' B_2')(A_1 B_1 + A_1' B_1') A_0 B_0'$

Comments:-

(i) The total no. of gates (NAND) required are = 41

(ii) Lower no. of gates results in.

- Reduced cost
- Reduction in complexity and interconnections (wiring)
- Lesser chances of troubleshooting.
- Smaller area covered by circuit on board.

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# CIRCUIT DIAGRAM: