# Assignment - 1

Page No.
Date:

Que 1 Write the short note on the logical gate.

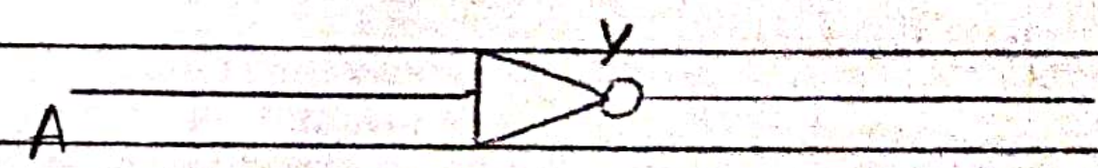
Ans logical gates → Logic gates are basic building blocks of digital circuits.
They take one or more inputs and give one output based on Boolean logic (0 or 1)

Types of Basic logic gates :-

1) NOT Gate (Inverter) →

- Only one input
- Output is the opposite of input → logical statement

Symbol →




IC No. → 7404 logical expression → $y = \bar{A}$

Truth table →

| I.P | O.P |
|---|---|
| A | y |
| 0 | 1 |
| 1 | 0 |

2) OR Gate →

Symbol →

logical statement → Any Input is 1, Output is 1

IC No. → 7432 logical expression → $Y = A + B$

Truth table →

| I.P | | O.P |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

3) AND Gate →

Symbol →

logical statement → If any input is 0, output is 0

IC NO → 7408.

Truth table →

| I.P | | O.P |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

logical expression →

$$y = A \cdot B.$$

4) NOR Gate (universal logic Gate) →

Symbol →

Page No.
Date:

logical statement → If any input is 1 output is 0

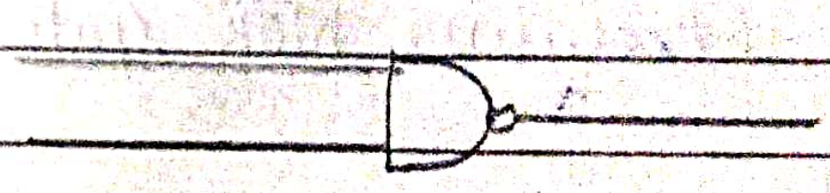
I.C No → 7402 logical expression → $y = \overline{A+B}$

Truth table →

| I.P | | O.P |
|---|---|---|
| A | B | y |
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

5] NAND Gate →

Symbol →



logical statement → Output is opposite of AND gate
Output is 0 only if all inputs are 1

I.C No. → 7400 logical expression → $y = \overline{A \cdot B}$

Truth table →

| I.P | | O.P |
|---|---|---|
| A | B | y |
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

6] XOR Gate → ( Exclusive OR Gate )

Symbol →

I.C No → 7486 logical expression →

$y = A\bar{B} + \bar{A}B$

logical statement → "Both input are same output is 0"

Truth Table →

| I.P | | O.P |
|---|---|---|
| A | B | y |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

7. XNOR Gate → (Exclusive NOR Gate)

Symbol → I.C No. → 74266

logical statement → Both input are same output is 1

Truth Table →

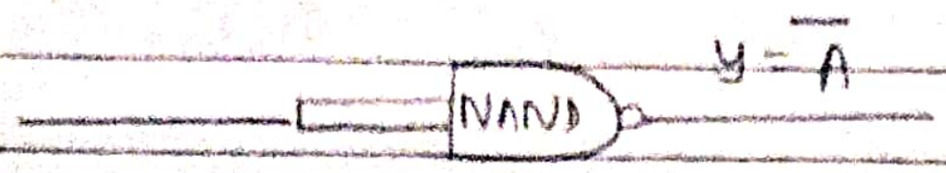
| I.P | | O.P |
|---|---|---|
| A | B | y |
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Page No.
Date:

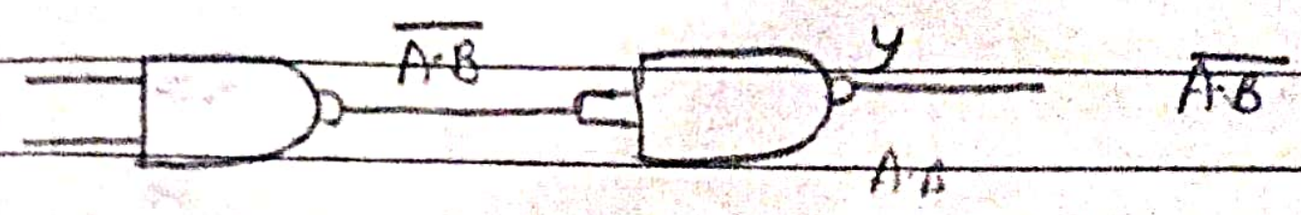
Que 3 Realise all the logic gate from the NAND gate

Ans:

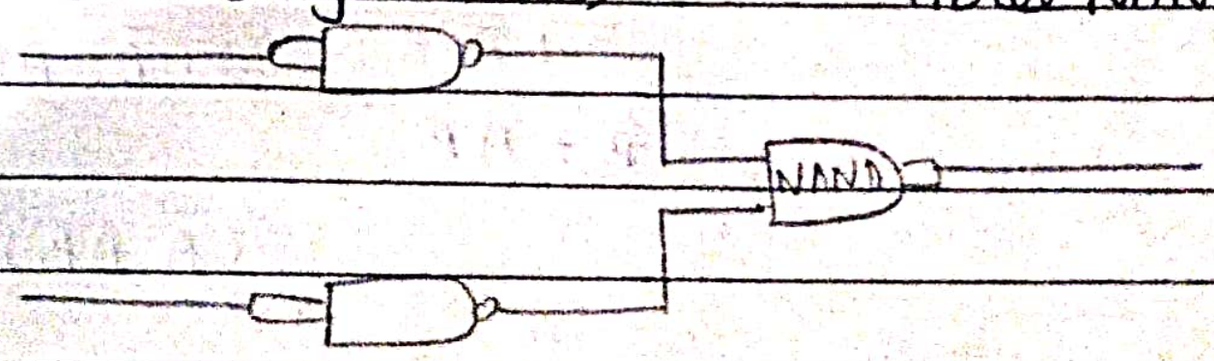
① NAND → NOT




② NAD → AND ( $y = A \cdot B$)




③ NAND → OR ( $y = A + B$) three NAND gate

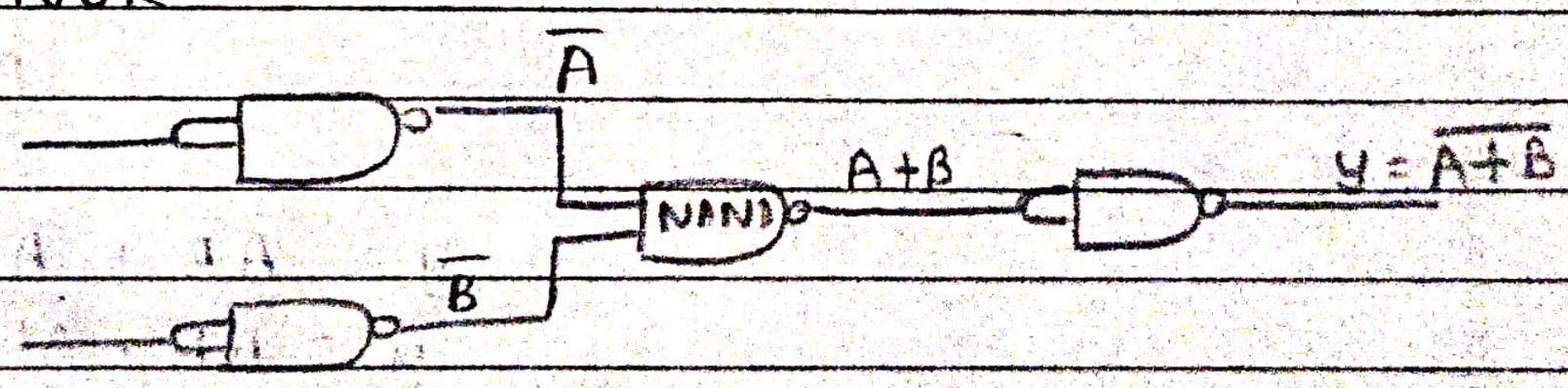



$y = \overline{A} \cdot \overline{B}$

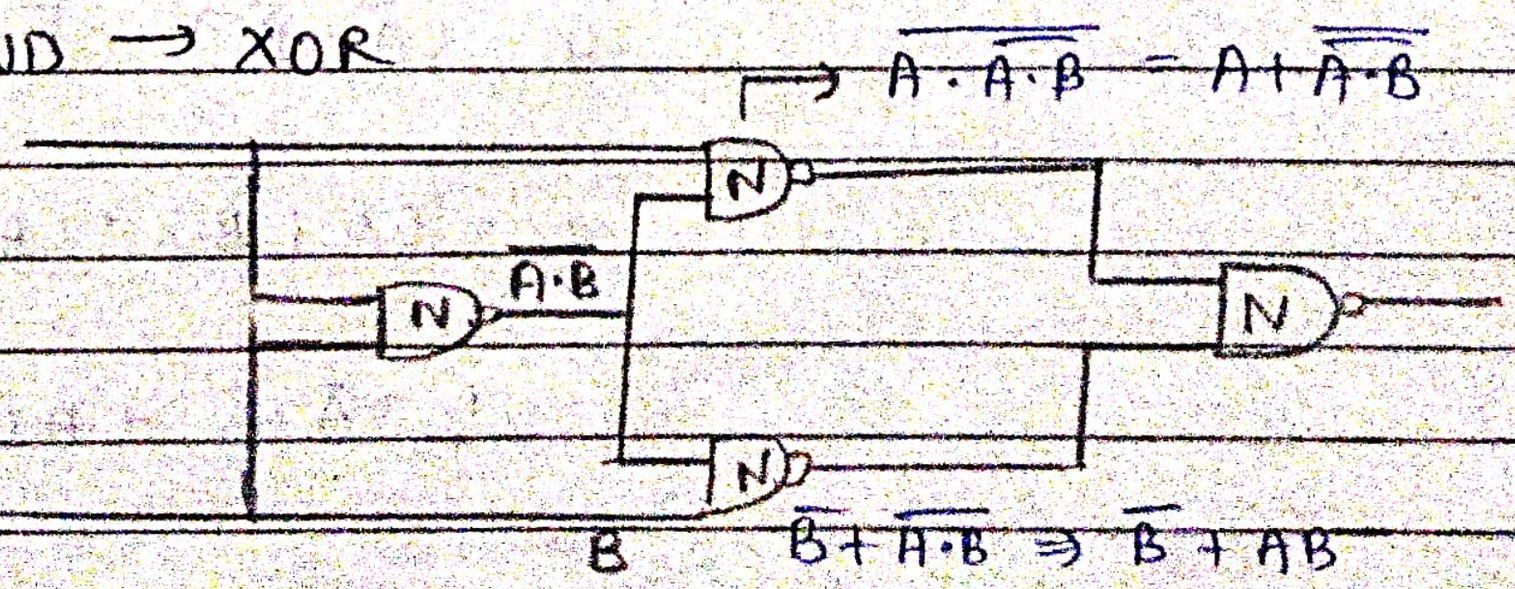
$y = \overline{\overline{A}} + \overline{\overline{B}}$

$y = A + B$

④ NAND → NOR




⑤ NAND → XOR



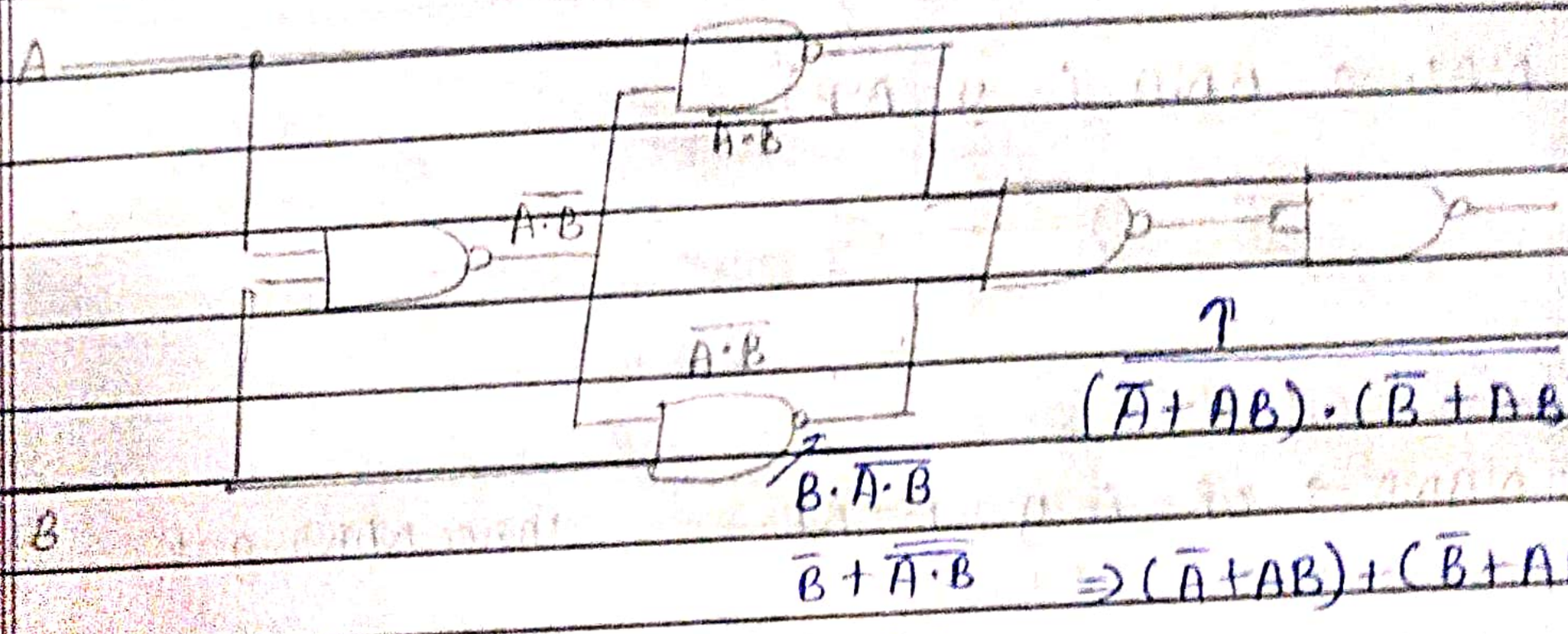
$$(A+AB)\cdot(\overline{B}+AB) = (\overline{A}+AB) + (B+\overline{A}B)$$

$$(\overline{A}\cdot\overline{AB}) + (\overline{B}\cdot\overline{AB})$$

$$A\cdot(\overline{A}+\overline{B}) + B\cdot(\overline{A}+\overline{B})$$

$$= A\overline{B} + \overline{A}B$$

⑥ NAND → XNOR $(y = A\cdot B + \overline{A}\cdot\overline{B})$




$$\overline{B} + \overline{\overline{A\cdot B}} \Rightarrow (\overline{A}+AB) + (\overline{B}+AB)$$

$$\overline{B} + AB$$

$$\Rightarrow (\overline{A}\cdot AB) + \overline{B}\cdot\overline{AB})$$

$$\Rightarrow A\cdot(A+B) + B\cdot(\overline{A}+\overline{B})$$

$$\Rightarrow A\overline{B} + \overline{A}B$$

$$y = A\overline{B} + \overline{A}B$$

$$y = \overline{A\overline{B}}\cdot\overline{\overline{A}B}$$

$$y = (\overline{A}+\overline{B})\cdot(\overline{\overline{A}}+B)$$

$$y = (\overline{A}+B)\cdot(A+\overline{B})$$

$$y = \overline{A}\cdot\overline{B} + AB$$

Page No.
Date:

(v) Realise all the logic gate from the NOR gate.

Ans:

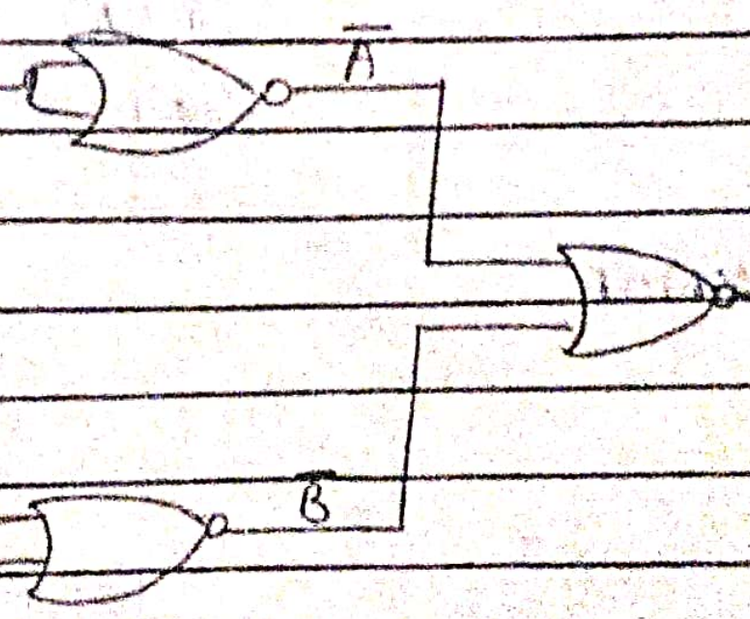
① NOR → NOT ($y = \overline{x}$)

② NOR → OR ($y = A+B$)

$y = \overline{\overline{A+B}}$

$\boxed{y = A+B}$

③ NOR → AND

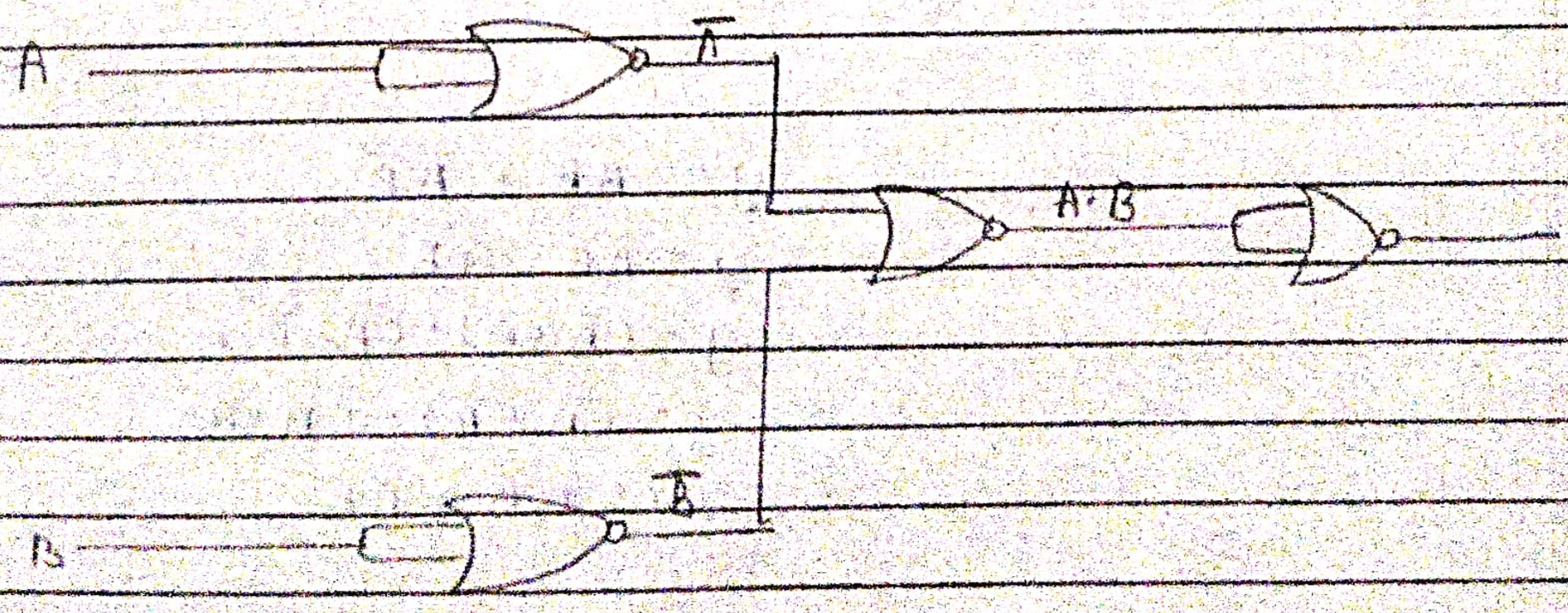



$y = \overline{\overline{A}+\overline{B}}$

$y = \overline{\overline{A}}+\overline{\overline{B}}$

$\boxed{y = A \cdot B}$

④ NOR → NAND



Page No.
Date:

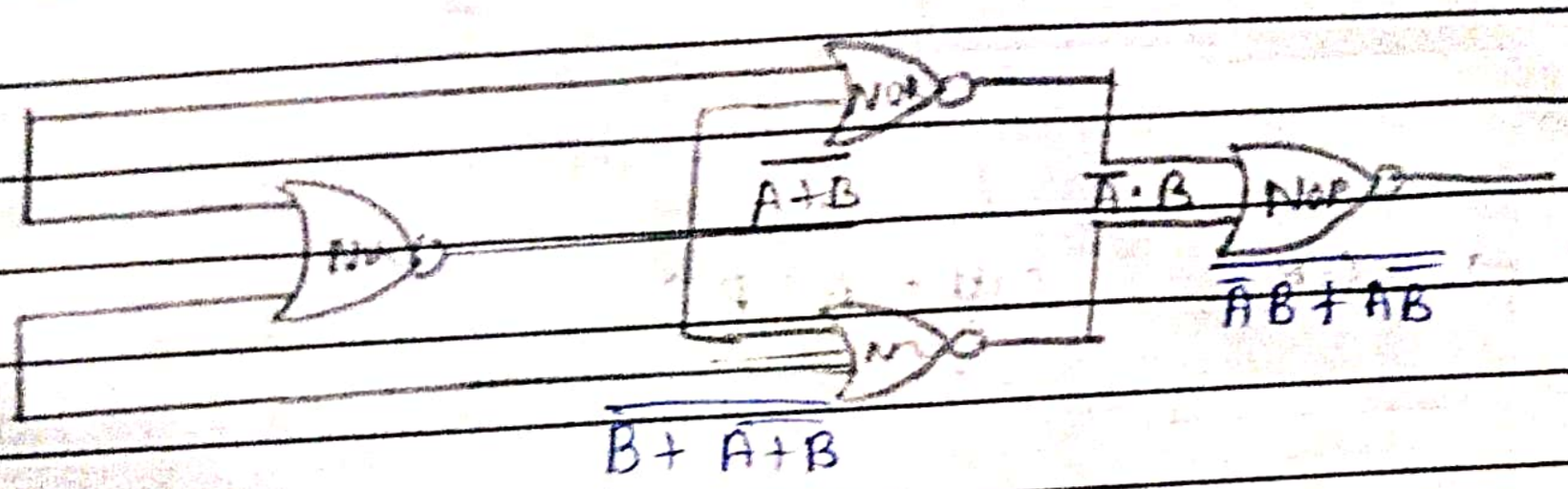
(5) NOR → XOR

$y = A\bar{B} + \bar{A}B$

$\overline{A + \overline{B + B}} \Rightarrow \bar{A} \cdot \overline{\bar{B} + B}$

$A \cdot (A + B)$

$0 + \bar{A} \cdot B$

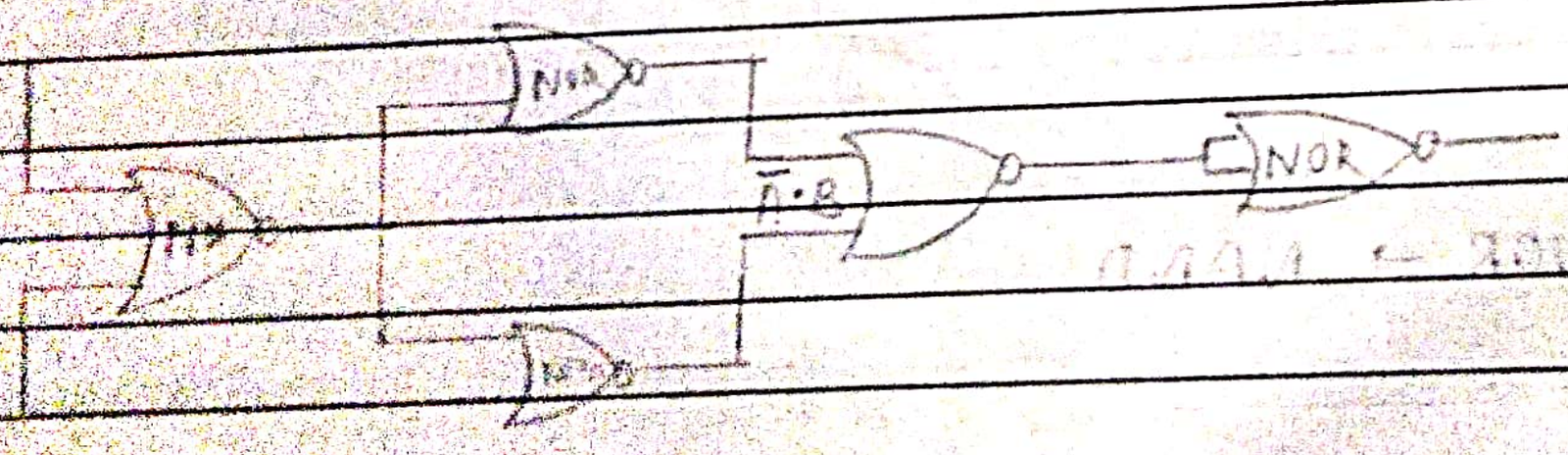



$\Rightarrow \bar{B} \cdot \overline{\overline{A+B}} \Rightarrow \bar{B} \cdot (A+B) \Rightarrow (\bar{\bar{A}} + \bar{B}) \cdot (\bar{A} + \bar{\bar{B}})$

$(A+B)$ $\quad (A + \bar{B}) \cdot (\bar{A} + B)$

$A\bar{B}$ $\quad AB + \bar{A} \cdot \bar{B}$

(6) NOR → XNOR




$y = \overline{AB + \bar{A}\bar{B}}$

$y = \overline{AB} \cdot \overline{\bar{A} \cdot \bar{B}}$

$y = (\bar{A} + \bar{B}) \cdot (\bar{\bar{A}} + \bar{\bar{B}})$

$y = (\bar{A} + \bar{B}) \cdot (A + B)$

$y = \bar{A}B + A\bar{B}$

Que=5 Write down all the boolean laws & give ex of

Ans= 1. De morgan's theorem:- Sum of complement of two or more variables is equal to the product of the complement of their variable.

① $\overline{A+B} = \overline{A} \cdot \overline{B}$

| I.P | | O.P | |
|---|---|---|---|
| A | B | A+B | $\overline{A+B}$ |
| 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 |

| I.P | | O.P | | |
|---|---|---|---|---|
| A | B | $\overline{A}$ | $\overline{B}$ | $\overline{A} \cdot \overline{B}$ |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 |

② $\overline{A \cdot B} = \overline{A} + \overline{B}$

| A | B | A·B | $\overline{A \cdot B}$ |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 |

| A | B | $\overline{A}$ | $\overline{B}$ | $\overline{A} + \overline{B}$ |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |

2. Commutative law

The sequence of changing the variable does not effect on the result even after changing their sequence while performing OR/AND operations of Boolean expression.

$A + B = B + A$

$A \cdot B = B \cdot A$

| A | B | A+B | B+A |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 |

3. Associative law

The order of operation on variables is independent

$A \cdot (B \cdot C) = (A \cdot B) \cdot C$ and $A + (B + C) = (A + B) + C$

Proof:

| A | B | C | B + C | A + (B + C) | A + B | (A + B) + C |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |

4. Distributive law

$A \cdot (B + C) = A \cdot B + A \cdot C$

$A + BC = (A + B)(A + C)$

5. AND laws

$A \cdot 0 = 0$

$A \cdot 1 = A$

$A \cdot A = A$

$A \cdot \bar{A} = 0$

6. OR laws

$A + 0 = A$

$A + 1 = 1$

$A + A = A$

$A + \bar{A} = 1$

Page No.
Date:

7) Inversion / complement / Not laws

$\overline{0} = 1$

$\overline{1} = 0$

$\overline{\overline{A}} = A$

8) $x + \overline{x}y = x + y$

$z + zm = \overline{z} + m$

$\overline{x} + x\overline{y} = \overline{x} + \overline{y}$

proof :-

| $x+y$ | $x$ | $y$ | $\overline{x}$ | $\overline{x}y$ | $x+\overline{x}y$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 | 1 |