

fifth class ( 3 March )

पृष्ठ

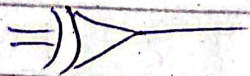
# LOGIC FUNCTIONS

- Logic function can be expressed in several ways

- 1) Truth table.
- 2) Logical expression.
- 3) Graphical forum.

$\bar{a}, \bar{a}$   
NOT

$\oplus$  XOR



0 0

1

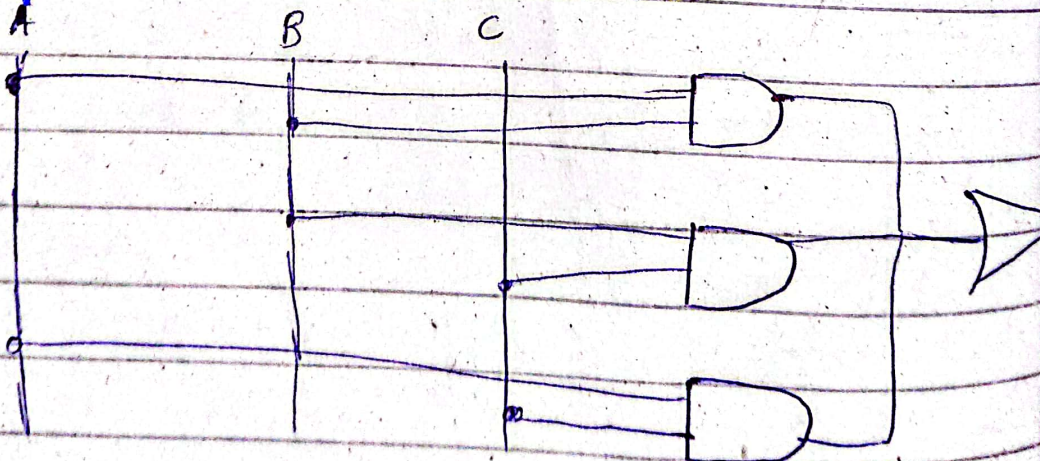
$\oplus$  XNOR



0 0

0

## LOGICAL EXPRESSIONS

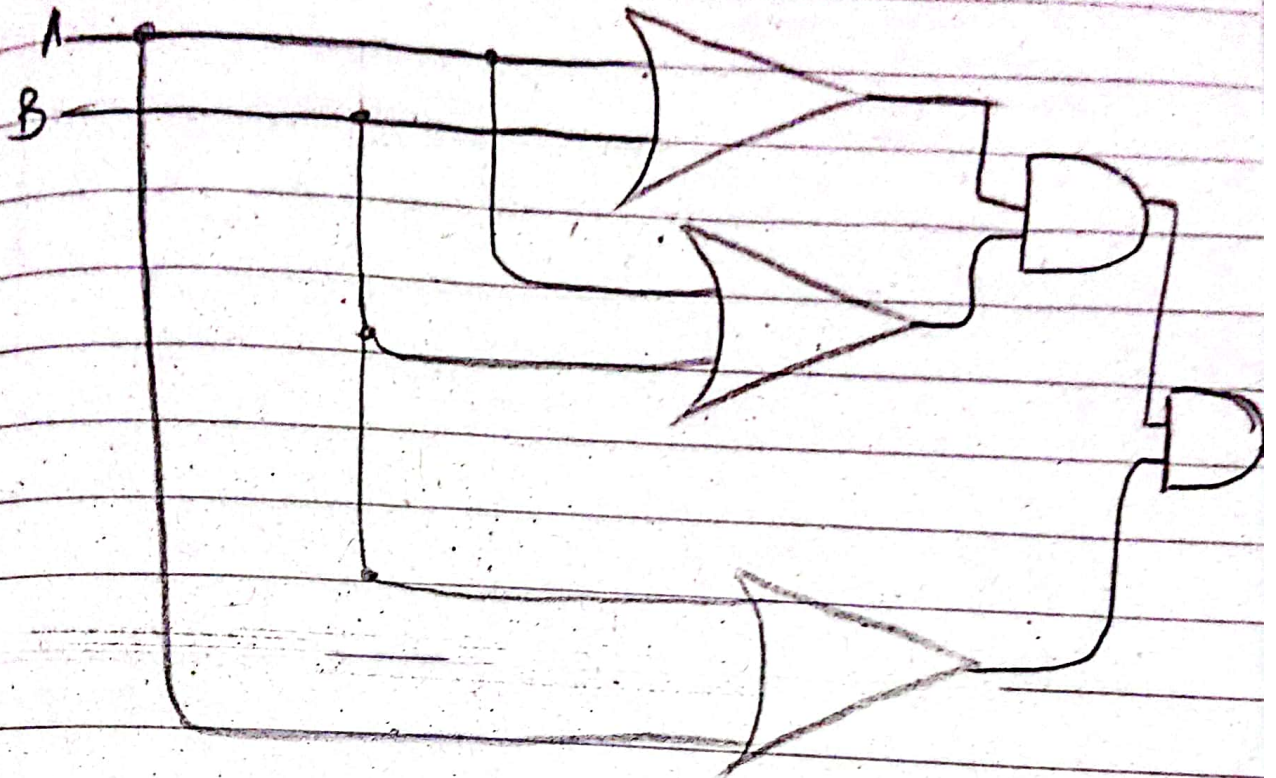




$$\{ Y = AB + BC + AC \}$$

LOGICAL EQUIVALENCE :

→ F3



→ F2



→ F1





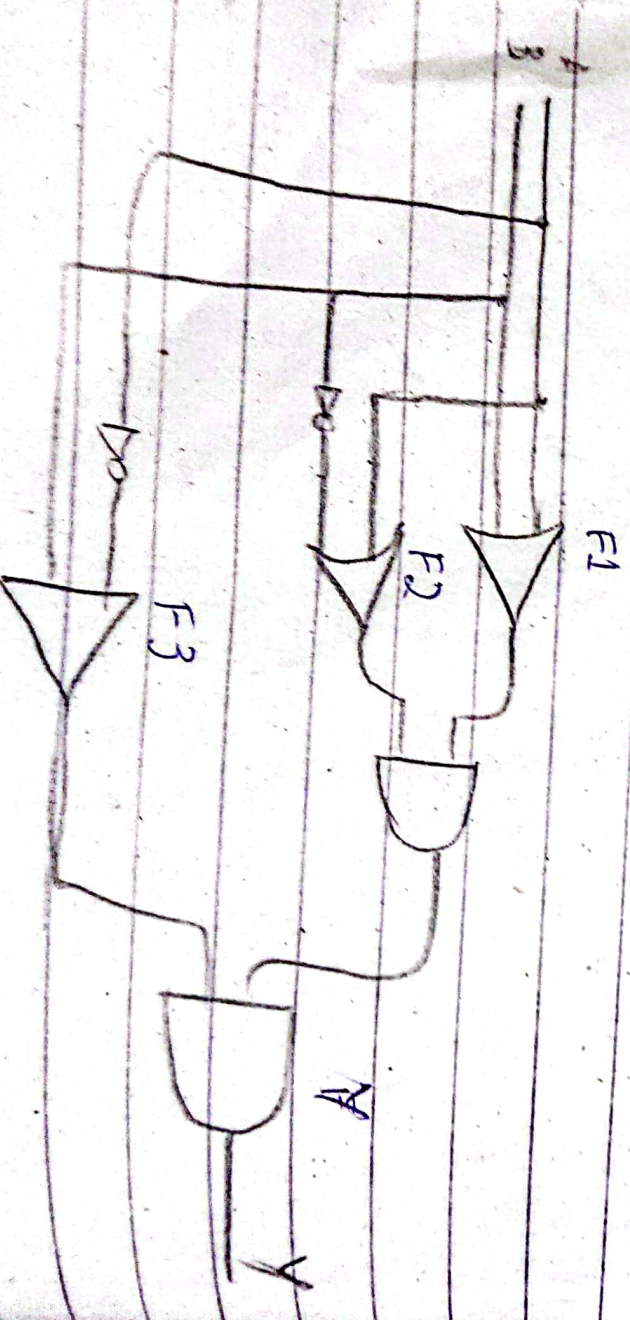
⇒ Proving logical equivalence of two circuits:

- You can use Truth table method
- You can use algebraic manipulation.
- Need Boolean identities

\* Derivation of logical expression from a circuit.

→ Trace from output to input.

• write down intermediate logical expression along the path.





$$Y = \left( (A+B) \times (A+B) \right) \{ A+B \}$$

| A | B | $\frac{A+B}{A+B}$ | Y |
|---|---|-------------------|---|
| 0 | 0 | 0                 | 0 |
| 0 | 1 | 1                 | 0 |
| 1 | 0 | 1                 | 0 |
| 1 | 1 | 1                 | 1 |





# BOOLEAN IDENTITIES

| Name              | AND version                                 | OR version   |
|-------------------|---|--|
| 1) Identity ✓     | $x \cdot 1 = x$                             | $x + 0 = x$  |
| 2) Complement     | $x \cdot \bar{x} = 0$                       | $x + \bar{x} = 1$  |
| 3) Commutative ✓  | $x \cdot y = y \cdot x$                     | $x + y = y + x$  |
| 4) Distributive ✓ | $x \cdot (y + z) = xy + xz$                 | $x + (y \cdot z) = (x + y) \cdot (x + z)$                                  |
| 5) Idempotent     | $x \cdot x = x$                             | $x + x = x$  |
| 6) Null ✓         | $x \cdot 0 = 0$                             | $x + 1 = 1$  |
| 7) Involution     | $\bar{\bar{x}} = x$                         | ---  |
| 8) Absorption     | $x \cdot (x + y) = x$                       | $x + (x \cdot y) = x$<br><del><math>x + (y + z) = (x + y) + z</math></del> |
| 9) Associative ✓  | $x \cdot (y \cdot z) = (x \cdot y) \cdot z$ | $x + (y + z) = (x + y) + z$  |
| 10) de Morgan     | $\overline{x \cdot y} = \bar{x} + \bar{y}$  | $\overline{x + y} = \bar{x} \cdot \bar{y}$                                 |



# LOGICAL EXPRESSION SIMPLIFICATION

→ Two Basic Methods

1) Algebraic manipulation

→ use Boolean laws to simplify the expression.

• difficult to use

• Don't know if you have simplified form.

2) Karnaugh map (K-map) method.

→ Graphical method

→ Easy to use (can be used to simplify logical expressions w/ variables)



## 1) ALGEBRIC MANIPULATION

⇒ Majority function example:

$$\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC = \bar{A}BC + A\bar{B}C + AB\bar{C} + \overbrace{ABC + ABC + ABC + ABC}$$

simply:-  $BC + AC + AB$

A difficult method to use for complex expression.

## TOPICS COVERED:-

logic functions

logical expressions

logical equivalence

Boolean Identities

logical expression simplification

algebraic Manipulation