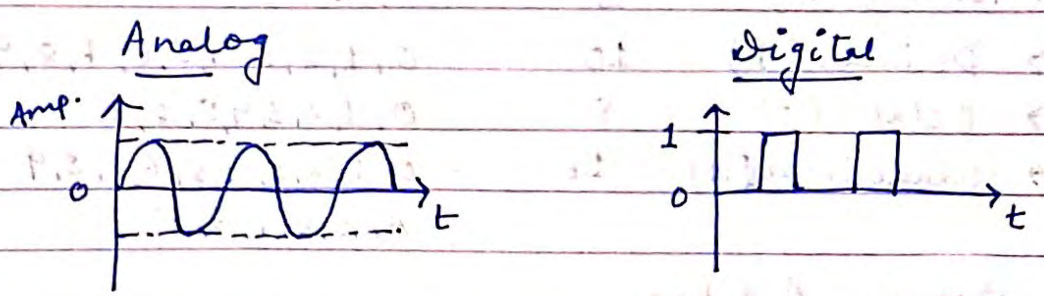
DIGITAL SYSTEM DESIGN

Unit - I

Introduction

In modern world of electronics, the term 'Digital' is usually associated with a computer. Now a days, digital concepts are usually applied to various problems like signal processing, digital computers, T.V. games, calculators, digital watches etc.

Analog Vs Digital



Parameters	Analog	Digital
1. No. of values	Infinite	Finite
2. No. of Signals	Continuous Time	Discrete Time
3. Sources of Signals	Signal Generators Transducers	Computer A to D converters
4. Examples	Sine wave Triangular wave	Binary Signal (0, 1)

Advantages of Digital System

- ★ Easy to design
- ★ Reliability and Reproducibility.
- ★ Flexibility
- ★ Functionality
- ★ Programmability
- ★ Economy in manufacturing

Digital

→ operates with binary numbers i.e. only in two states

Two states

0	1
LOW	HIGH
FALSE	TRUE
OFF	ON
OPEN	CLOSE

Positive Logic

0 → OFF → 0 Volt

1 → ON → +5 Volts

Negative Logic

0 → ON → +5 volts

1 → OFF → 0 volt

Number System

	Base	
→ Binary (B)	2	0, 1
→ Decimal (D)	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
→ Octal (O)	8	0, 1, 2, 3, 4, 5, 6, 7
→ Hexadecimal (H)	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9 A, B, C, D, E, F

Boolean Algebra

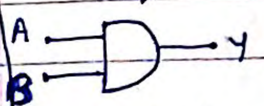
In year 1854 → George Boole invented a new kind of algebra called Switching or Boolean algebra.

Boolean Algebra involves the manipulation of boolean variables that can have only two values either logic 0 or logic 1.

Boolean logic functions (or) operations

AND

Symbol



Boolean Expression: $Y = A \cdot B$

Truth Table

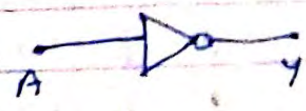
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR

$Y = A + B$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

NOT (INVERTOR)



$Y = \overline{A}$

A	Y
0	1
1	0

Boolean Algebra laws :→

(1) Commutative Law $A+B = B+A$

$A \cdot B = B \cdot A$

(2) Associative Law $A+(B+C) = (A+B)+C$

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

(3) Distributive Law $A \cdot (B+C) = A \cdot B + A \cdot C$

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

★ Proof of $A+BC = (A+B)(A+C)$

L.H.S $A+BC = A \cdot 1 + B \cdot C$

$= A(1+B) + BC$ {Since $1+B = 1$}

$= A \cdot 1 + AB + BC$

$= A(1+C) + AB + BC$ {Since $1+C = 1$}

$= A \cdot 1 + AC + AB + BC$

$= A \cdot A + AC + AB + BC$ {Since $A \cdot A = A$}

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

$= (A+B)(A+C)$ = R.H.S

Hence Proved

Absorption Laws

(1) $A + AB = A$

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

(3) $A + \bar{A}B = A+B$

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

Proof

(1) $A + AB = A(1+B) = A$

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

$= A + AB$

$= A(1+B)$

$= A$

(3) $A + \bar{A}B$

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

$= A(1+B) + \bar{A}B$

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

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

$= A + B$