Digital circuits.

Boolean algebra & logic gates ('0' & '1')
→ Cost of the circuit
→ Simple realization of a circuit.

* George Boole :→ developed an algebraic system (Boolean algebra)

→ OR (+) @ '|' @ ∪ @ ∨ } binary operators.
→ AND (•) (or) ∩ @ & @ && }
→ NOT. or inverter → unary operators.

→ In boolean algebra:

$A + A = A$

$A \cdot A = A$.

→ In ordinary algebra

$A + A = 2A$

$A \cdot A = A^2$

→ In binary no system

$1+1 = (10)$

$1 \cdot 1 = 1$

Axioms & postulates.

$x + 0 = x$ $\qquad$ $x \cdot 0 = 0$

$x + 1 = 1$ $\qquad$ $x \cdot 1 = 1$

$x + x = x$ $\qquad$ $x \cdot x = x$

$x + \bar{x} = 1$ $\qquad$ $x \cdot \bar{x} = 0$

$(\bar{\bar{x}})$ or $(x')' = x$.

OR operation (logical addition)
ANA operation (logical multiplication)

1. Commutative law : $x+y = y+x$ | $x \cdot y = y \cdot x$.
2. Associative law : $x+(y+z) = (x+y)+z$

   $x \cdot (y \cdot z) = (x \cdot y) \cdot z$
3. Distributive law :

   (i) $x(y+z) = xy + xz$.

   (ii) $x + yz = (x+y)(x+z)$

Absorption theorem:

1. $x + xy = x$.

   $\rightarrow x(1+y) = x \cdot 1 = \underline{\underline{x}}$

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

2. $x + \bar{x}y = x + y$.

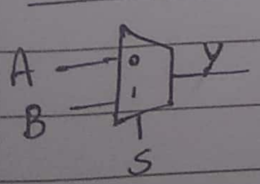
   $(x+\bar{x})(x+y)$

MUX to logic gates:

1. NAND, NOR - Universal gate.

* MUX $\rightarrow$ Universal logic

2:1 MUX



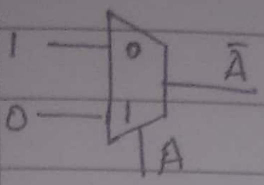
2^n = inputs.

$n \rightarrow$ selection lines.

S	Y
0	A
1	B

$y = A\bar{S} + BS$.

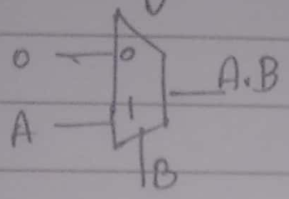
Inverter Design:



$y = 1.\bar{A} + 0.A$

$Y = \bar{A}$

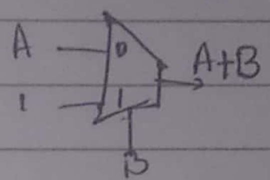
AND gate using MUX.



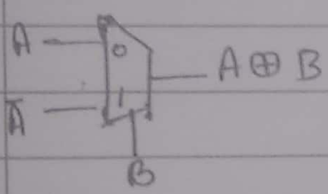
$y = 0.\bar{B} + A.B$

$y = A.B.$

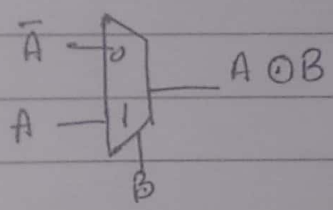
OR gate.



XOR



Ex-NOR



BCD to 7-segment decoder.

A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	1	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1