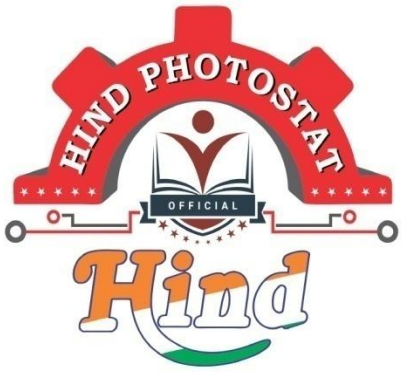

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ELECTRONICS ENGINEERING

Digital Electronics

By- DHANANJAY Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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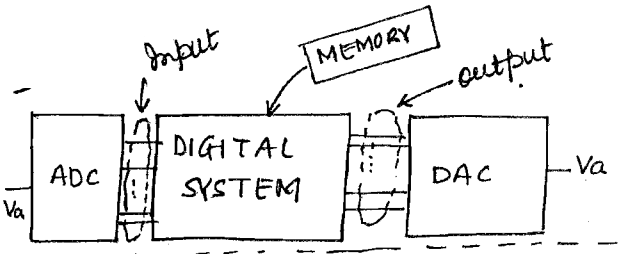


µP → ALU → Adder & Sub
DSP → Control unit → Decoder or MUX
µC → Registers & Counters → FLIP FLOPS
} LOGIC GATES → BJT OR MOSFET OR DIODES

FPGA → Field Programmable Gate Array.
↓
The place where we use the device

SYLLABUS :.

I) Basics
- → Boolean Algebra.
- → Logic Gates.
- → K MAP
- → Number systems; Codes and Data Representation.

II) Combinational circuits :.

i) Arithmetic circuits
- → HA, FA, HS, FS
- → Parallel Adder
- → Look Ahead carry Adder.
- → BCD Adder.
- → 2's complement Adder ckt

** ii) MULTIPLEXER (Every Gate & IES paper)...
iii) DEMUX
iv) DECODER
v) ENCODER
vi) COMPARATOR
vii) CODE CONVERTOR
viii) PARITY GENERATORS/CHECKERS

III) Sequential circuits :.
- i) Flip Flops.
- ii) Registers.
- iii) Counters.
- iv) State Machines
  - → Mealy
  - → Moore

Newly Added in GATE

IV) ADC's & DAC's.

V) LOGIC FAMILIES :.
- i) RTL
- ii) DCTL
- iii) IIL
- iv) DTL
- v) HTL
- vi) TTL
- vii) ECL

} BJT Based. ← Not included in GATE.

- i) NMOS
- ii) PMOS
- iii) CMOS

} FET Based. (Mainly GATE).

VI) Basics of Semiconductor Memories.
- i) RAM.
- ii) ROM.
- iii) PAL, PLA
- iv) PROM.

*Preperation Strategy:-

i) Class Notes.

ii) Practising Previous Papers.

- GATE
  - ECE
  - EE
  - IN
  - CSE
- IES.
  - ECE
  - EEE

iii) Reference Books:-

- M. Mano
- Roth.
- Jaub & schilling (ADC & DAC, logic families).

*BOOLEAN ALGEBRA:

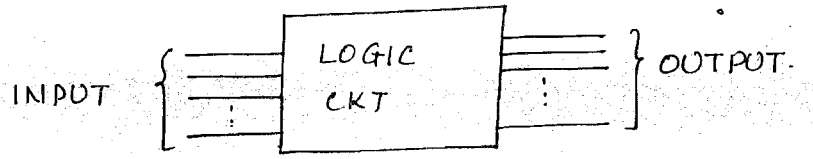
* Introduced in 1854 by GEORGE BOOLE.
* No xtor we available that time, hence designed with help of
  i) VENN DIAGRAM
  ii) SWITCHES → OFF (LOGIC 0), ON (LOGIC 1)

* Boolean Algebra only handles "0 and 1".

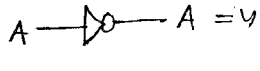
A, B, C } VARIABLES → 0, 1 } Boolean Algebra

* To minimize logical expressions following methods are used
  i) Boolean Algebra (1, 2, 3 variables max^m)
  ii) K Map (2, 3, 4, 5 variables at max^m)
  iii) Quine Mc'cluskey or TABULATION METHOD (Any no. of variables)
* Boolean Algebra is used when o/p is either "0 or 1"
  K Map is used when o/p is either "0, 1 or x"

*THEOREMS IN BOOLEAN ALGEBRA:



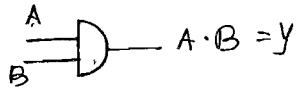
i) NOT:



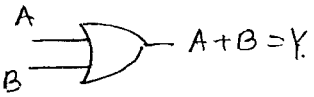
* Note:

$\bar{\bar{A}} = A$ ← NOT operation Relation.

ii) AND:



iii) OR:



AND OPERATION

$0 \cdot 0 = 0$
$0 \cdot 1 = 0$
$1 \cdot 0 = 0$
$1 \cdot 1 = 0$

$A \cdot A = A$
$A \cdot 0 = 0$
$A \cdot 1 = A$
$A \cdot \bar{A} = 0$

← AND-OPERATION THEOREM

OR OPERATION :.

$0+0 = 0$
$0+1 = 1$
$1+0 = 1$
$1+1 = 1$

OR-OPERATION THEOREM

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

Q1) Minimize logic expression :.

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

Soln :. $Y = AB + A\bar{B}$

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

$\boxed{Y = A}$

Q2) To implement logical exp; $Y = AB + A\bar{B}C + A\bar{B}\bar{C}$; min^m no. of 2 input NAND Gates

a) 0 b) 1 c) 2 d) 3

Soln :. $\boxed{Y = AB + A\bar{B}C + A\bar{B}\bar{C}}$ ← SOP FORM

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

$= AB + A\bar{B}$

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

$\boxed{Y = A}$ ← NO Gates Required

Q3) Minimize logic expression ; $y = (A+B)(A+C)$

Soln :. $\boxed{Y = (A+B)(A+C)}$ ← POS FORM.

$Y = A \cdot A + A \cdot C + A \cdot B + B \cdot C$

$Y = A + AC + AB + BC$

$Y = A(1 + C + B) + BC$

$\boxed{Y = A + BC}$ ← SOP FORM

Analysis :-

$(A+B)\cdot(A+C)$ → 3 variables.

SAME LITERALS

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

Q4) Minimize ; $(x+y)(x+\bar{y})(\bar{x}+y)$

Soln :- $(x+y\cdot\bar{y})(\bar{x}+y)$

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

$= xy$

Q5) Minimize ; $(x+y+z)(x+y+\bar{z})$

Soln :- $(x+y+z)(x+y+\bar{z})$

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

$(x+y)$

Q6) Minimize

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

Soln :- $(A+B\cdot\bar{B})(\bar{A}+B\cdot\bar{B})$

$A\cdot\bar{A}$

$= 0.$

Q7) Minimize ; $y = A+\bar{A}B$

Soln :- $y = A+\bar{A}B$

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

$y = (A+B)$

Note :-

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

$(A+BC) = (A+B)(A+C)$ ← DISTRIBUTION THEOREM.

$(1+2\cdot3)\quad(1+2)\ (1+3).$

Q8) Minimize ;

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

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

iii) $\bar{A}+AB \rightarrow (\bar{A}+A)(\bar{A}+B) = (\bar{A}+B)$

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

Q9) Minimum no. of logic gates required for $y = AB+\bar{A}C+A\bar{B}$

Soln :- $y = AB+\bar{A}C+A\bar{B}$

$= A(B+\bar{B})+\bar{A}C$ ∵

$= A+\bar{A}C$

$= (A+\bar{A})(A+C)$ ∴

$y = A+C$

Note :- The precedence order of the LOGIC SYMBOLS is :-

( ) > NOT > AND > OR → SOP

( ) > NOT > OR > AND ← POS.

Q10) Minimize ; $y = A\bar{B} + \bar{A}C + BC$

Soln:. $y = A\bar{B} + \bar{A}C + BC$

Note:. 3 variable Available

↳ Repeated Twice
↳ Complement on $A + \bar{A}$

$$\boxed{Y = A\bar{B} + \bar{A}C + BC = A\bar{B} + \bar{A}C}$$

$$\boxed{(A\bar{B} + \bar{A}C + BC) = (A\bar{B} + \bar{A}C)}$$ ← CONSENSUS THEOREM.

Q11) Minimize logical expression:.

i) $\bar{A}B + AC + BC = \bar{A}B + AC$
ii) $A\bar{B} + AC + BC = A\bar{B} + BC$
iii) $AB + AC + B\bar{C} = AC + B\bar{C}$

} ← SOP FORM.

POS FORM {
iv) $(A+B)(\bar{A}+C)(B+C) = (A+B)(\bar{A}+C)$
v) $(A+B)(A+C)(B+\bar{C}) = (A+C)(B+\bar{C})$
}

vi) $A\bar{B} + \bar{A}C + \bar{B}C = A\bar{B} + \bar{A}C$

vii) $\bar{A}\bar{B} + \bar{A}\bar{C} + B\bar{C} = \bar{A}\bar{B} + B\bar{C}$

Note:.
*check those literals where $A + \bar{A}$ are present ie one Literal A is uncomplemented and $\bar{A}$ is complemented.

*Analysis:.

$$(A+B)(\bar{A}+C) = A\cdot\bar{A} + AC + \bar{A}B + BC$$
$$= AC + \bar{A}B$$

$$\boxed{(A+B)(\bar{A}+C) = AC + \bar{A}B}$$ ← TRANSPOSITION THEOREM.

Q12) Minimize; $y = (A+B)(\bar{A}+\bar{B})$

Soln:. $y = (A+B)(\bar{A}+\bar{B})$

$$\boxed{Y = A\bar{B} + \bar{A}B = A \oplus B}$$

Q13) Minimize ; $y = (A+\bar{B})(\bar{A}+B)$

Soln:. $y = (A+\bar{B})(\bar{A}+B)$

$$\boxed{Y = AB + \bar{A}\bar{B} = A \odot B}$$