Gate Delay

the delay between an input change(s) and the resulting output change. (t_G)

it can be represented by timing diagram.

For truth table

such that

A	B	C	D	F

D is the least digit

A is the most digit. → truth tables are unique

The boolean expression

such → $x + \bar{y}z$

Precedence

→ parentheses

→ NOT

→ AND

→ OR.

The boolean function

$F = x + \bar{y}z.$

* Truth tables are unique, expressions and logic diagrams are not.

flexibility for implementation.

Identities

Basic

مكمل (.) وال (+)

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

Other important

$x+y=y+x$	$(x+y)+z=x+(y+z)$	$x\cdot(y+z)=(x\cdot y)+(x\cdot z)$
$x\cdot y=y\cdot x$	$(x\cdot y)\cdot z=x\cdot(y\cdot z)$	$x+(y\cdot z)=(x+y)\cdot(x+z)$

DeMorgan's ✓

$\overline{x+y}=\bar{x}\cdot\bar{y}$ ✓

$\overline{x\cdot y}=\bar{x}+\bar{y}$ ✓

Theorems

Minimization

$xy+\bar{x}y=y$ ← عامل مشترك

Absorption

$x+xy=x$

مهمين للبراهين والتبسيط

Simplification

$x+\bar{x}y=x+y$ توزيع جمع على ضرب

Consensus

اجماع

$xy+\bar{x}z+yz=xy+\bar{x}z$

Converting function to SOM or POM

→ use the truth table → use boolean algebra.

Sum of Product (SOP)

→ logical sum of AND terms that are not necessarily represented as Minterms.

→ SOP often represent a simplified. expression of SOM.

Special case: (weird)

$F(A,B,C,D) = \bar{A}\bar{B}CD \Rightarrow (SOM)$

← اذا كان عدد الحدود قليل، وبحتاج ازيد متغيرات . بضرب كل حد بقوس المتغير الناقص . (اصل لـ SOM)

← عكسه نستخدم توزيع الجمع على الضرب لما نحول لـ(POM) وتكون الحدود قلال.
وبعدين بصير اضيف المتغيرات الناقصة.

Product of Sum (POS)

Same Idea of (SOP)

Special case: (weird)

$F(A,B,C) = (\bar{A}+B+C) \Rightarrow (POM)$

COST ⇒ it can be found by L, G, GN

karnaugh-maps (K-Maps)

→ simplify
→ optimize
→ derive POS from SOP

↳ each square represent a Minterm.
↳ Grey code
↳ prime implicants + essential prime implicants

Don't cares :- $\Sigma d(-,-,-)$

① cases:
- input values for the minterm will never occur
- output value for the minterm is not used.

② it helps to lower the cost of logic circuit

* it appears when using ~~xxx~~ BCD to design a logic circuit and such thing.

deriving POS

→ first find $\bar{F}$ by evaluation zeros - rectangles

→ derive F as POS by doing duality the complementing it.

↳ when there is don't cares they're combined with zeros in their rectangle,

وبقلك تشغيره
وبيعطيني شو ال
items
الي بيشتغلو ✓

Simple Approach :-

1. functional block ✓
2. truth table
3. functions
4. diagram ✓

k inverters

بيكون عليها السلاك بعدد ال inputs ← 2^k Ands

$GN = k + 2^k * k$

inverters

And Gates

Straight forward design. ←

 # Expansion Approach :- less GN ✓

عدد ال Ands هو عدد ال 2^k، بس بيكون عليها سلكين فقط لا غير ✓ دائماً

$k/2$ → even, take it as is
→ odd. (ceiling, then floor)

how to calculate GN for expansion Approach.

$Ands * 2 + k = \underline{GN}$

* GN never differ between small decoders when designing them using straight forward design or expansion approach. ✓

it differs for the big decoders. ✓