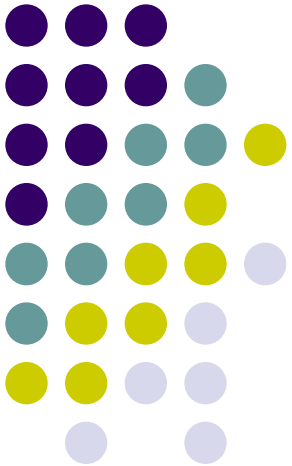
Mata Kuliah
Dasar Teknik Digital



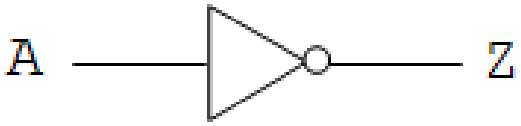
GERBANG LOGIKA dan

ALJABAR BOOLEAN

Gerbang Dasar - NOT

- penyangkalan dengan kata-kata **"*tidak*"** (NOT)

  1`= 0  dan  0` = 1

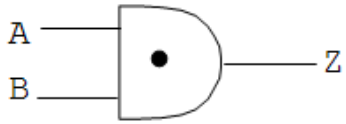


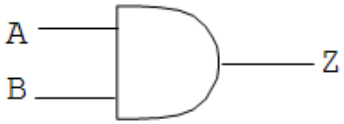
Tabel Kebenaran **NOT**

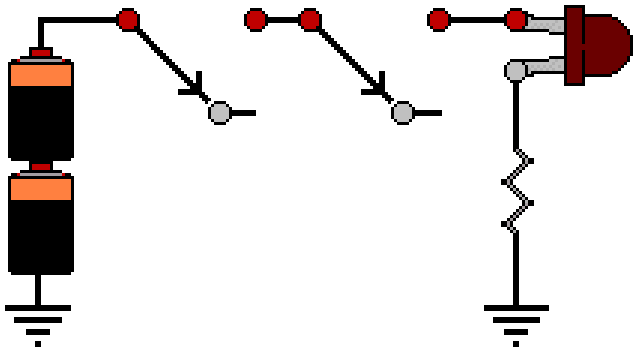
A	$Z = \overline{A}$
0	1
1	0

Gerbang Dasar - AND

- AND : Z = A.B = AB





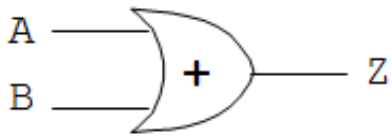


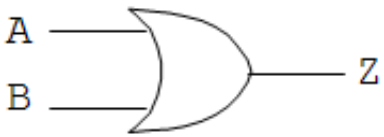
animasi

masukan		keluaran
A	B	Z= A.B
0	0	0
0	1	0
1	0	0
1	1	1

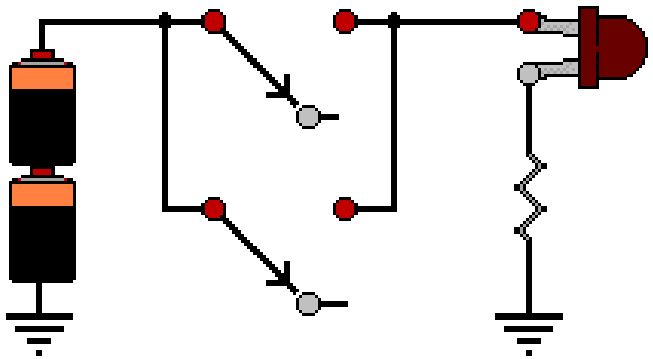
Gerbang Dasar - OR

- OR : Z = A+B





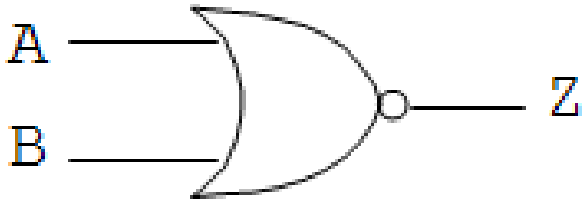
masukan		keluaran
A	B	Z= A+B
0	0	0
0	1	1
1	0	1
1	1	1

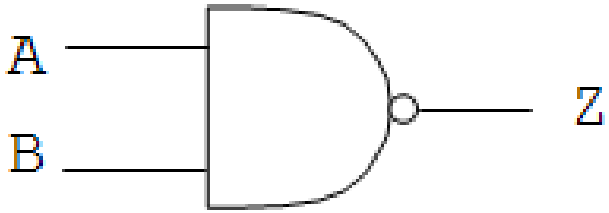


animasi

Gerbang Tambahan

- NOR : Z = (A + B)`  NAND : Z = (A B)`



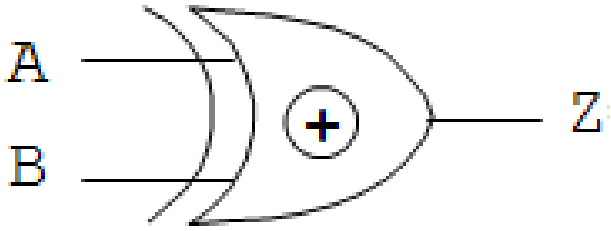


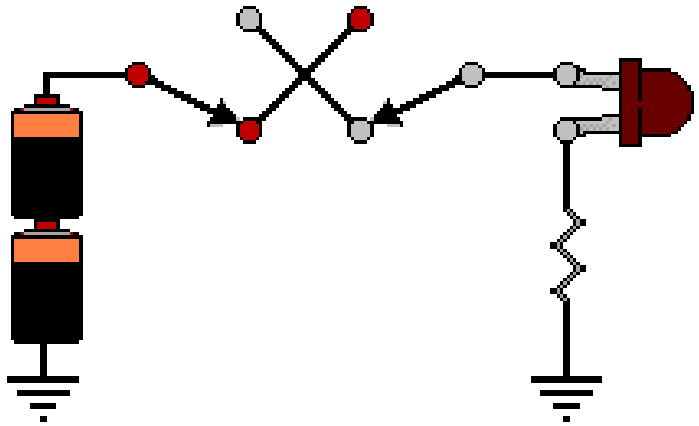
A	B	$Z=\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

A	B	$Z=\overline{A\ B}$
0	0	1
0	1	1
1	0	1
1	1	0

Gerbang Tambahan

- EXOR : $Z = A \oplus B$





animasi

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	0

Logika Kombinasi

- Rangkaian kombinasi adalah rangkaian aplikasi yang terbentuk dari berbagai macam gerbang logika dan dapat merupakan kombinasi dari satu jenis gerbang logika atau lebih.
- Penyederhanaan rangkaian terintegrasi dapat menggunakan aljabar boole atau peta karnaugh

CONTOH.

Buatlah rangkaian dengan Gerbang Logika untuk kombinasi sbb.

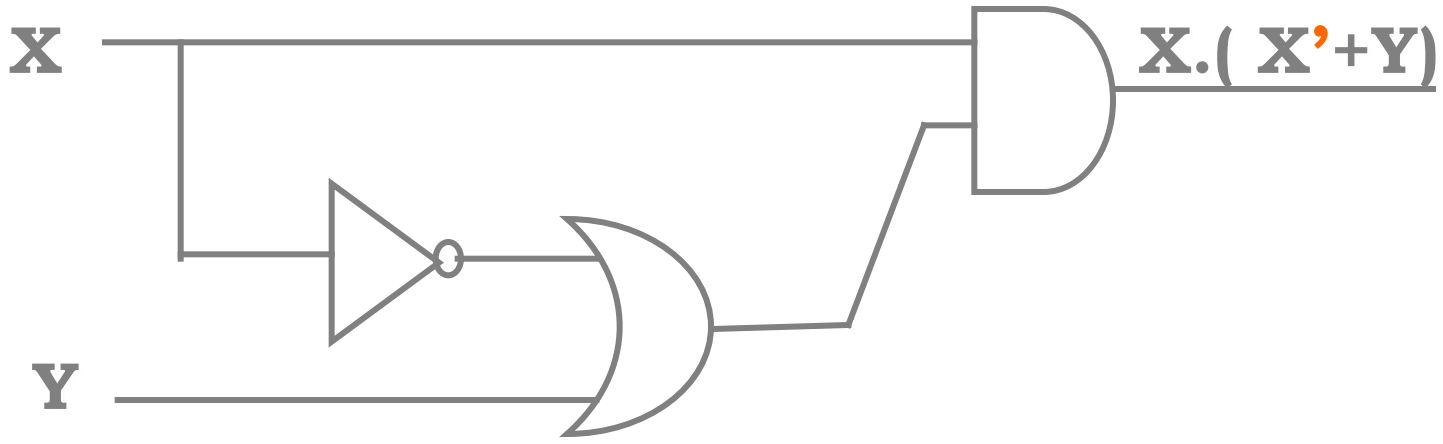
$$Q = X \cdot (X' + Y)$$

CONTOH.

Buatlah rangkaian dengan Gerbang Logika untuk kombinasi sbb.

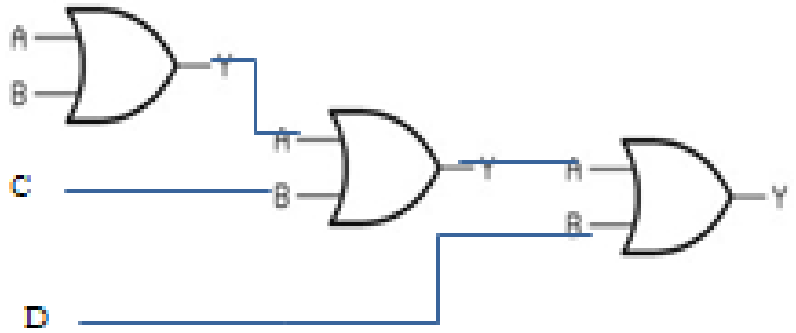
Q = X . (X' + Y)

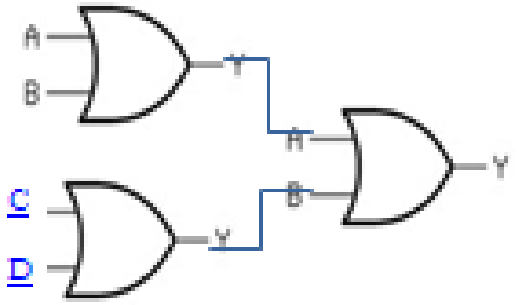
Jawab.



Contoh 2.

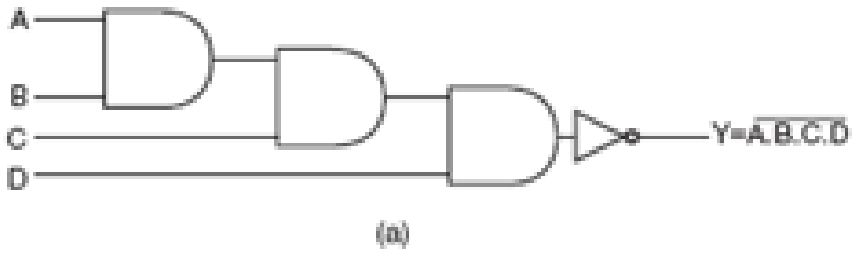
- Bagaimana cara mengaplikasikan gerbang OR 4 masukan dengan menggunakan gerbang OR 2 masukan?



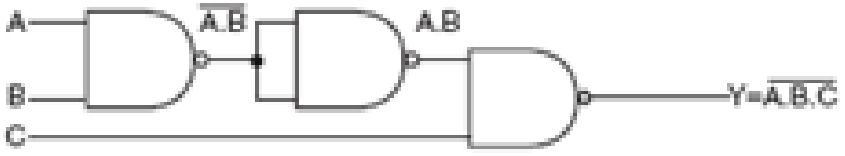


Contoh 3 .

- Gerbang NAND 4 input menggunakan gerbang AND 2 input dan 1 inverter
- Gerbang NAND 3 input menggunakan gerbang NAND 2 input



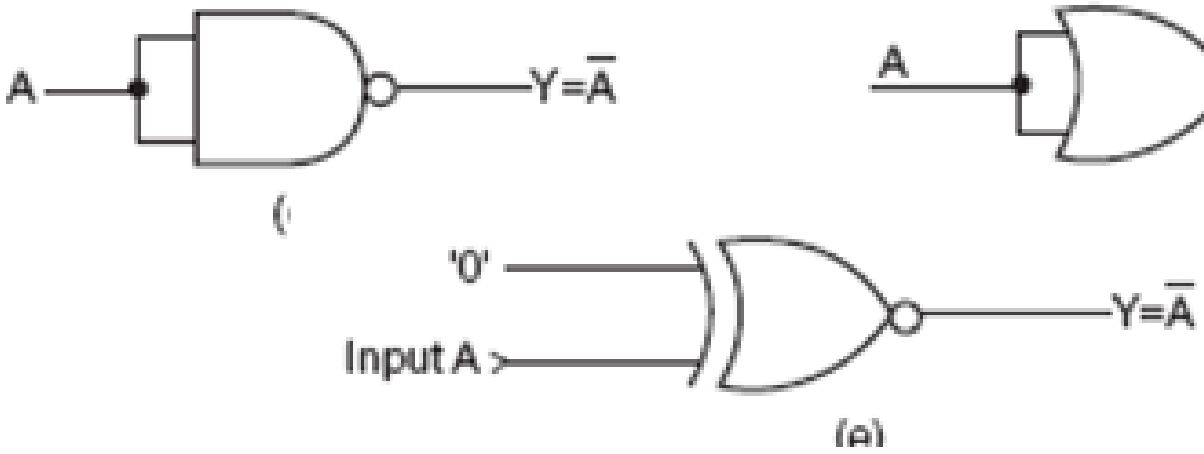
(a)



(b)

Contoh 4

- Rangkaian NOT menggunakan 2 input gerbang NAND
- Rangkaian NOT menggunakan 2 input gerbang NOR
- Rangkaian NOT menggunakan 2 input gerbang XOR



Teorema Dasar Boole

1. Operasi dengan 0 dan 1	$x + 0 = x$ $\quad x.0 = 0$ $x + 1 = 1$ $\quad x.1 = x$
2. Hukum Idempoten	$x + x = x$ $x.x = x$
3. Hukum Involusi	$\bar{\bar{x}} = x$
4. Hukum Komplement	$x + \bar{x} = 1$ $\quad x.\bar{x} = 0$
5. Hukum Kumutatif	$x + y = y + x$ $x.y = y.x$
6. Hukum Assosiatif	$(x+y)+z = x+(y+z) = x+y+z$ $(xy)z = x(yz) \quad = xyz$
7. Hukum Distributif	$x(y+z) = xy+xz$ $x+yz = (x+y)(x+z)$

Teorema Tambahan Boole

1. Teorema penyederhanaan:	$x\,y + x\,\bar{y} = x$ $x + x\,y = x$ $(x + \bar{y})\,y = x\,y$ $(x+y)(x+\bar{y}) = x$ $x\,(x+\bar{y}) = x$ $x\bar{y} + y = x + y$
2. Hukum de Morgan:	$\overline{x + y + z + \ldots} = \bar{x}\,\bar{y}\,\bar{z}\ldots$ $\overline{x \,.\, y \,.\, z \,.\, \ldots} = \bar{x} + \bar{y} + \bar{z} + \ldots$
3. Teorema Konsensus:	$xy + yz + \bar{x}z = xy + \bar{x}z$ $(x+y)(y+z)(\bar{x}+z) = (x+y)(\bar{x}+z)$ $(x+y)(\bar{x}+z) = xz + \bar{x}y$
4. Dualitas	$(x + y + z + \ldots)^D = x\,y\,z$ $(x\,y\,z\ldots)^D = x + y + z + \ldots.$ $[f(x_1, x_2, x_3, \ldots, x_n, 0, 1, +, .)]^D = f(x_1, x_2, x_3, \ldots, x_n, 0, 1, +, .)$

Hukum de Morgan

$$\overline{A + B} = \overline{A} \,.\, \overline{B}$$

(i) When $A = 0, \quad B = 0,$

$$\overline{A + B} = \overline{0 + 0} = \overline{0} = 1$$

and $\quad \overline{A} \,.\, \overline{B} = \overline{0} \,.\, \overline{0} = 1 \,.\, 1 = 1$

Hence $\quad \overline{A + B} = \overline{A} \,.\, \overline{B}$

(ii) When $A = 0, \quad B = 1,$

$$\overline{A + B} = \overline{0 + 1} = \overline{1} = 0$$

and $\quad \overline{A} \,.\, \overline{B} = \overline{0} \,.\, \overline{1} = 1 \,.\, 0 = 0$

Hence $\quad \overline{A + B} = \overline{A} \,.\, \overline{B}$

(iii) When $A = 1, \quad B = 0,$

$$\overline{A + B} = \overline{1 + 0} = \overline{1} = 0$$

and $\quad \overline{A} \,.\, \overline{B} = \overline{1} \,.\, \overline{0} = 0 \,.\, 1 = 0$

Hence $\quad \overline{A + B} = \overline{A} \,.\, \overline{B}$

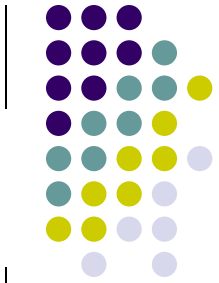
(iv) When $A = 1, \quad B = 1,$

$$\overline{A + B} = \overline{1 + 1} = \overline{1} = 0$$

and $\quad \overline{A} \,.\, \overline{B} = \overline{1} \,.\, \overline{1} = 0 \,.\, 0 = 0$

Hence $\quad \overline{A + B} = \overline{A} \,.\, \overline{B}$

Hukum de Morgan $\overline{A \cdot B} = \bar{A} + \bar{B}$



(i) *When* $A = 0, \quad B = 0,$

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

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

Hence $\overline{A \cdot B} = \bar{A} + \bar{B}$

(ii) *When* $A = 0, \quad B = 1,$

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

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

Hence $\overline{A \cdot B} = \bar{A} + \bar{B}$

(iii) *When* $A = 1, \quad B = 0,$

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

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

Hence $\overline{A \cdot B} = \bar{A} + \bar{B}$

(iv) *When* $A = 1, \quad B = 1,$

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

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

Hence $\overline{A \cdot B} = \bar{A} + \bar{B}$

Penyajian Fungsi Boole

- ***sukumin*** (singkatan dari "suku minimum" ***minterm***, minimum term)

→ Sum Of Product, nilai 1

$$m_0 + m_1 + m_2 + ... + m_{n-1} = \sum_{i=0}^{n-1} m_i = \sum m(0,1,2,...,n-1)$$

- ***sukumax*** (singkatan dari "suku maksimum" ***maxterm***, maximum term)

→ Product of sum, nilai 0

$$M_0 \; M_1 \; M_2 \; .... \; M_{n-1} = \prod_{i=0}^{n-1} M_i = \prod M(0,1,2,...,n-1)$$

contoh

A	B	C	f
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

$$f = \Sigma\, m\,(1,3,4,6)$$

$$= \Pi\, M\,(0,2,5,7)$$

$$f = \bar{A}\,\bar{B}\,C + \bar{A}\,B\,C + A\,\bar{B}\,\bar{C} + A\,B\,\bar{C}$$

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

Fungsi Tidak Lengkap

- ‘d’ (dont care), dapat dianggap 1 ataupun 0 tergantung pertimbangan desain
- Contoh : $y = \Sigma\, m\,(0,3,7) + \Sigma\, d\,(1,6)$,

A	B	C	y
0	0	0	1
0	0	1	x
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	x
1	1	1	1

Latihan

1. Gambarkan Gerbang Logika AND, OR, NOT, EXOR dan EXNOR [simbol dan table kebenaran]
2. Gambarkan Gerbang Logika NAND, NOR, [simbol dan table kebenaran]
3. Buatlah rangkaian dan tabel kebenaran dari soal latihan berikut ini: Z = A + (B.C)
4. Buatlah rangkaian dan tabel kebenaran dari soal latihan berikut ini: Z = (A+B). A’

NB:

symbol matematis dari gerbang logika **AND** diwakili dengan simbol (.)

OR diwakili dengan simbol (+) **NOT** diwakili dengan simbol (')