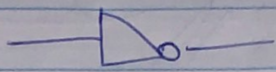
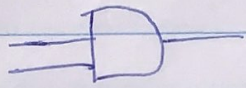
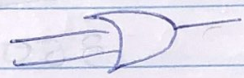
Tutorial - logic design

1) NOT 

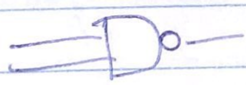
A	X
0	1
1	0

AND 

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

OR 

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

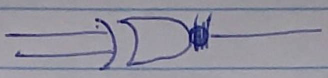
NAND 

A	B	X
0	0	1 ~~1~~
0	1	1 ~~0~~
1	0	1 ~~0~~
1	1	0 ~~0~~

NOR 

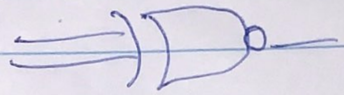
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

XOR



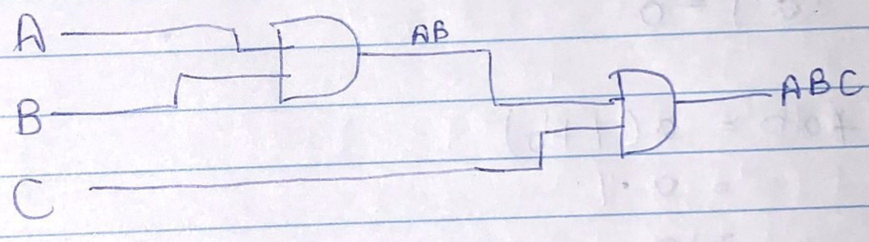
A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

EXNOR

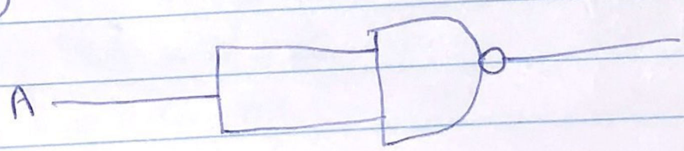


A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

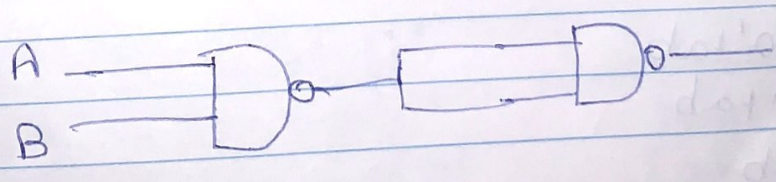
2



3



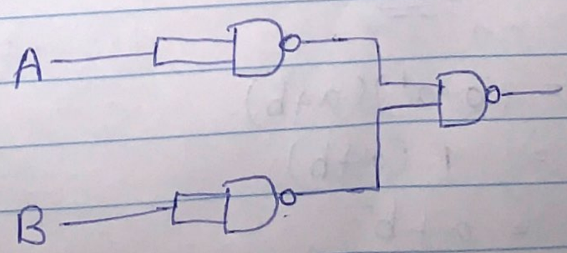
4



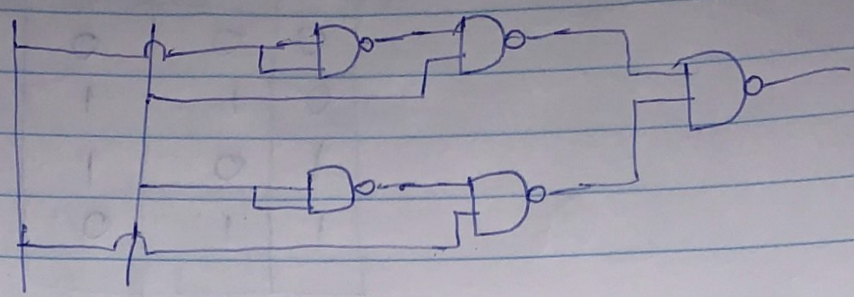
5 $A+B$

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

$= \overline{\bar{A}\,\bar{B}}$



(6) A B



(7) AND, OR, NOT

(8) $xy = yx$ $x+y = y+x$

$(ab)c = a(bc)$ $(a+b)+c = a+(b+c)$

$a(b+c) = ab+ac$ $a+bc = (a+b)(a+c)$

$(a+b)' = a'b'$

$(a+b+c+\ldots)' = a'b'c'\ldots$

$(a')' = a$

(9) • $a+ab = a(1+b)$

$= a\cdot 1$

$= \underline{a}$

• $a(a+b) = aa+ab$

$= a+ab$

$= \underline{a}$

• $a(a'+b) = aa'+ab$

$= 0+ab$

$= \underline{ab}$

• $a+a'b = (a+a')(a+b)$

$= 1(a+b)$

$= \underline{a+b}$

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Date: __/__/____

- $(a+bc)' = a'(bc)'$
  $= \cancel{a'(b'+c')}$

- $(a+b)(a+b')$
  $= a(a+b') + b(a+b')$
  $= aa + ab' + ba + bb'$
  $= a + ab' + ab + 0$
  $= a + ab' + ab$
  $= a(1 + b' + b)$
  $= a$

- $ab + ab'c$
  $= a(b + b'c)$
  $= a[(b+b')(b+c)]$
  $= a\,1\,(b+c)$
  $= a(b+c)$
  $= ab + ac$

- $(a+b)(a+b'+c)$
  $= a + b(b'+c)$
  $= a + bb' + bc$
  $= a + 0 + bc$
  $= a + bc$

- $(a(b+z(x+a')))'$
  $= a' + (b + z(x+a'))'$
  $= a' + b'(z(x+a'))'$
  $= a' + b'[z' + (x+a')']$
  $= a' + b'[z' + (x'a)]$
  $= a' + b'z' + b'x'a$

  $(ab + az(x+a'))'$
  $(ab + z(ax + aa'))'$
  $(ab + z(ax + 0))'$
  $(ab + axz)'$
  $(a(b + xz))'$
  $a' + (b + xz)'$
  $a' + (b'(xz)')$
  $a' + b'(x' + z')$

Scanned with CamScanner

- $$(a(b+c)+a'b)'$$
$$= (ab+ac+a'b)'$$
$$= (b(a+a')+ac)'$$
$$= (b1+ac)'$$
$$= (b+ac)'$$
$$= b'(a'+c')$$

- $$(a+b)(a'+c)(b+c) \overset{?}{=}$$
$$= (a'(a+b)+c(a+b))(b+c)$$
$$= (a'a+a'b+ac+bc)(b+c)$$
$$= (0+a'b+ac+bc)(b+c)$$
$$= (b(a'+c)+ac)(b+c)$$
$$= b(a'+c)b+acb+bc(a'+c)+acc$$
$$= b(a'+c)+abc+bc(a'+c)+ac$$
$$= b(a'+c)+bc(a+(a'+c))+ac$$
$$= b(a'+c)+bc(1+c)+ac$$
$$= b(a'+c)+bc+ac$$
$$= a'b+bc+bc+ac$$
$$= a'b+bc+ac$$
$$= b(a'+c)+ac+aa'$$
$$= b(a'+c)+a(a'+c)$$
$$= (a'+c)(a+b)$$

(10)

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

(11)

$$x = A'B'C + A'BC + AB'C + ABC$$
$$= BC(A'+A) + B'C(A+A')$$
$$= BC + B'C$$
$$= C(B+B')$$
$$= C$$

(12) $\bar{A}(\bar{B}C + \bar{B}\bar{C}) + \bar{A}B\bar{C}$

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

C \ AB	00	01	11	10
0	1	1	0	0
1	1	0	0	0

$\bar{A}\cancel{B}$ $\bar{A}\bar{C} + \bar{A}\bar{B}$

No :

(13) $\bar{A}(\bar{B}C + \bar{B}\bar{C}) + \bar{A}B\bar{C}$

C \ AB	00	01	11	10
0	1	1	0	0
1	1	0	0	0

$\bar{X} = A + BC$

$X = (\overline{A + BC})$

$= \bar{A}(\overline{BC})$

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

(13)

A	B	C	D	X
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

CD \ AB	00	01	11	10
00	1	1	1	1
01	0	0	0	0
11	0	0	0	0
10	1	1	1	1

$x = D$

0	0	0	0	0	0	0	
1	0	0	0	0	0	1	
2	0	0	0	0	1	0	
3	0	0	0	0	1	1	AN
4	0	0	0	1	0	0	
5	0	0	0	1	0	1	AN
6	0	0	0	1	1	0	
7	0	0	0	1	1	1	AN
8	0	0	1	0	0	0	
9	0	0	1	0	0	1	
10	0	0	1	0	1	0	
11	0	0	1	0	1	1	AN
12	0	0	1	1	0	0	
13	0	0	1	1	0	1	AN
14	0	0	1	1	1	0	
15	0	0	1	1	1	1	
16	0	1	0	0	0	0	
17	0	1	0	0	0	1	AN
18	0	1	0	0	1	0	
19	0	1	0	0	1	1	AN
20	0	1	0	1	0	0	
21	0	1	0	1	0	1	
22	0	1	0	1	1	0	
23	0	1	0	1	1	1	AN
24	0	1	1	0	0	0	
25	0	1	1	0	0	1	
26	0	1	1	0	1	0	
27	0	1	1	0	1	1	
28	0	1	1	1	0	0	
29	0	1	1	1	0	1	AN
30	0	1	1	1	1	0	
31	0	1	1	1	1	1	AN
32	1	0	0	0	0	0	
33	1	0	0	0	0	1	
34	1	0	0	0	1	0	
35	1	0	0	0	1	1	
36	1	0	0	1	0	0	
37	1	0	0	1	0	1	AN
38	1	0	0	1	1	0	
39	1	0	0	1	1	1	
40	1	0	1	0	0	0	
41	1	0	1	0	0	1	AN
42	1	0	1	0	1	0	
43	1	0	1	0	1	1	AN
44	1	0	1	1	0	0	
45	1	0	1	1	0	1	
46	1	0	1	1	1	0	
47	1	0	1	1	1	1	AN
48	1	1	0	0	0	0	
49	1	1	0	0	0	1	
50	1	1	0	0	1	0	

(14)

DE \ ABC	000	001	011	010	110	111	101	100
00	0	0	0	0	0	0	0	0
01	0	1	1	0	0	1	0	1
11	1	1	0	1	0	1	1	1
10	1	0	0	0	0	0	0	0

$$X = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{C}DE + \bar{A}C\bar{D}E + \bar{B}DE + ABCE + A\bar{B}\bar{C}D$$

(15)

DEF \ ABC	000	001	011	010	110	111	101	100
000	0	0	0	0	0	0	0	0
001	0	0	0	1	0	0	1	0
011	0	1	0	1	0	0	1	0
010	1	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0
111	1	0	1	1	0	0	1	0
101	1	1	1	0	0	0	0	1
100	0	0	0	0	0	0	0	0

$$Y = \bar{A}\bar{B}\bar{C}\bar{D}E\bar{F} + \bar{B}C\bar{D}EF + \bar{A}B\bar{C}\bar{D}\bar{F} + A\bar{B}C\bar{D}F$$
$$+ A\bar{B}CEF + D\bar{E}F + \bar{A}BCDF + \bar{A}\bar{E}DE\bar{F}$$