Electronics Homework set #6

1.) ⓐ $A \cdot B = \overline{\bar{A} + \bar{B}}$:

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

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

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

ⓒ $A \cdot 1 = A$

A	B	$A \cdot B$
0	1	0
1	1	1

d.) $\overline{A \cdot A} = \bar{A}$

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

e.) $A + 1 = 1$

A	B	$A+B$
0	1	1
1	1	1

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1.) cont

f.) $\overline{A+A} = \bar{A}$

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

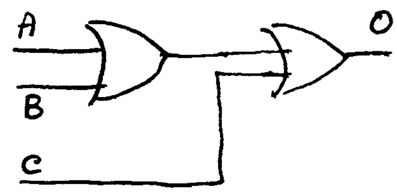
g.) $A+0 = A$

A	B	$A+B$
0	0	0
1	0	1

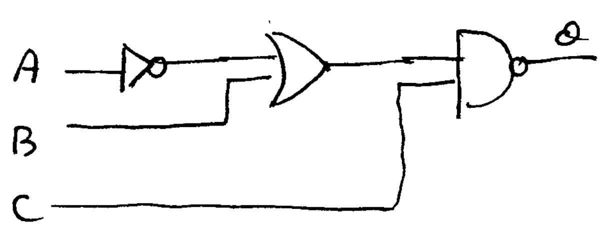
h.) $A \cdot 0 = 0$

A	B	$A \cdot B$
0	0	0
1	0	0

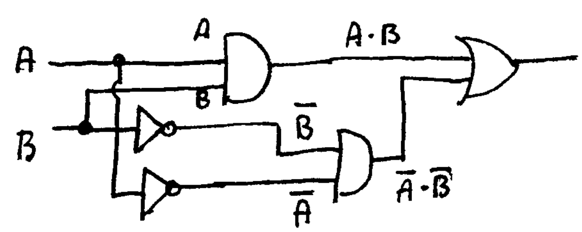
2.) (a) $Q = A+B+C = (A+B)+C$:



(b) $\bar{Q} = (\bar{A}+B)\cdot C \Rightarrow (\bar{\bar{Q}}) = \overline{(\bar{A}+B)\cdot C} = Q$

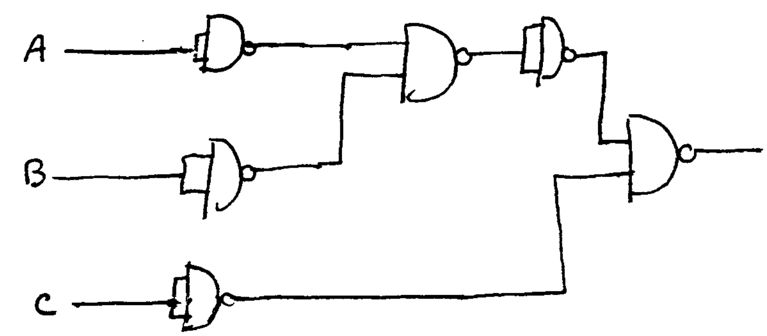


c.) $Q = A\cdot B + \bar{A}\cdot\bar{B}$:



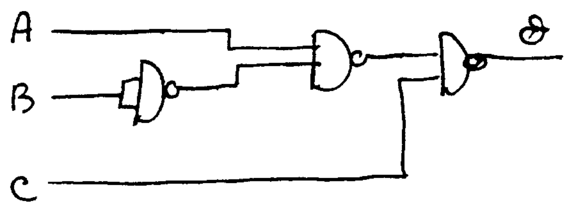
3.) a.) $A+B = \overline{\bar{A}\cdot\bar{B}} = \overline{(\overline{A\cdot A})\cdot(\overline{B\cdot B})}$

so $(A+B)+C = \overline{\left[\overline{(\overline{A\cdot A})\cdot(\overline{B\cdot B})}\right]\cdot(\overline{C\cdot C})}$

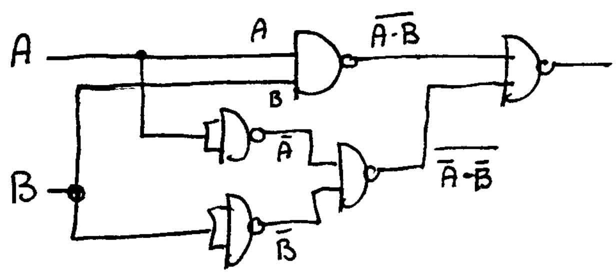


b.) $\bar{\vartheta} = (\bar{A}+B)\cdot C \Rightarrow \vartheta = \overline{(\bar{A}+B)\cdot C}$

$= \overline{(\overline{A\cdot\bar{B}})\cdot C}$



c.) $\vartheta = A\cdot B + \bar{A}\cdot\bar{B} = \overline{(\overline{A\cdot B})\cdot(\overline{\bar{A}\cdot\bar{B}})}$



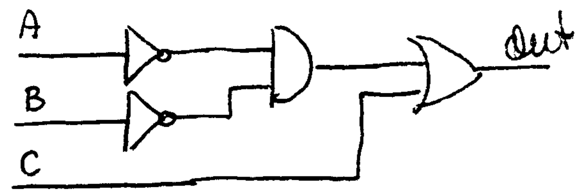
4.)

use $\bar{A} = \overline{A\cdot A}$;

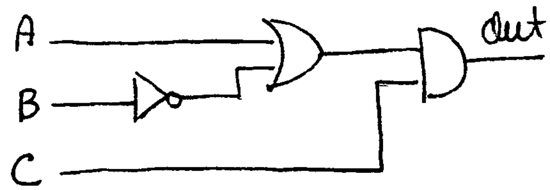
$A+B = \overline{\bar{A}\cdot\bar{B}}$;

See #3 for details

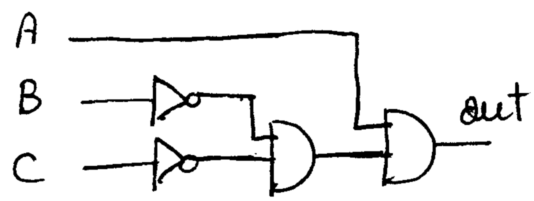
5.) a.) $(\bar{A} \cdot \bar{B}) + C = Out$:



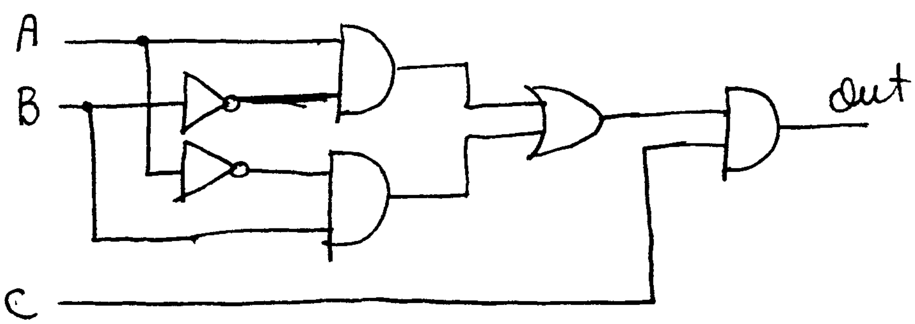
b.) $(A + \bar{B}) \cdot C = Out$



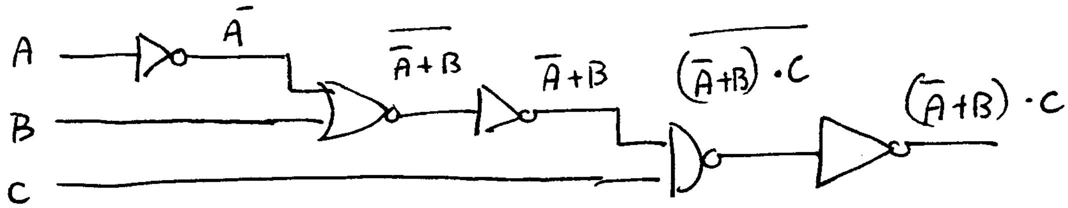
c.) $A \cdot (\bar{B} \cdot \bar{C}) = Out$



d.) $[(A \cdot \bar{B}) + (B \cdot \bar{A})] \cdot C = Out$

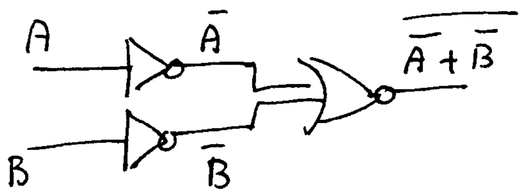


6.) a.)



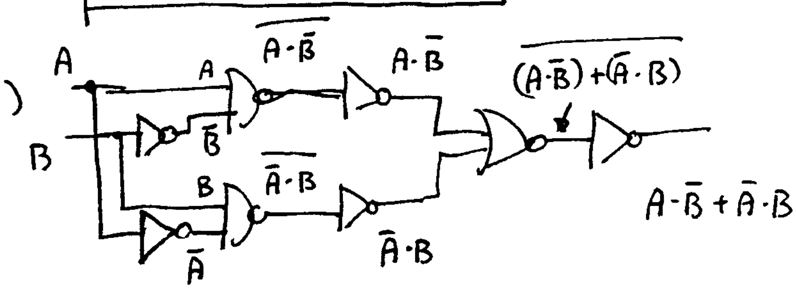
$$\boxed{Q = (\overline{A}+B)\cdot C}$$

b)



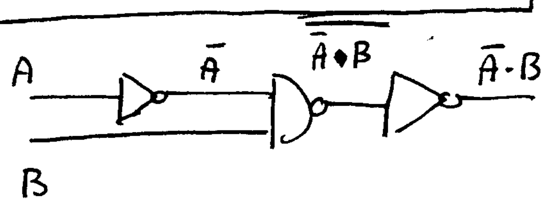
$$\boxed{Q = \overline{\overline{A}+\overline{B}} = A\cdot B}$$

c.)



$$\boxed{Q = A\cdot\overline{B}+\overline{A}\cdot B = A\oplus B}$$

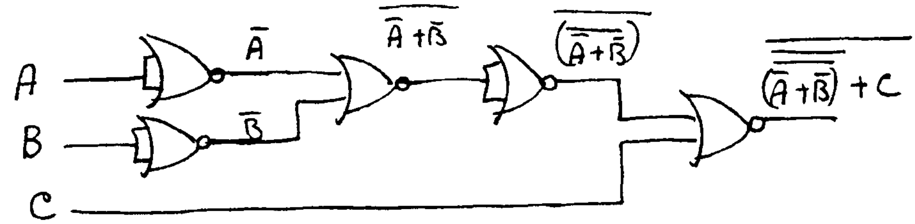
d.)



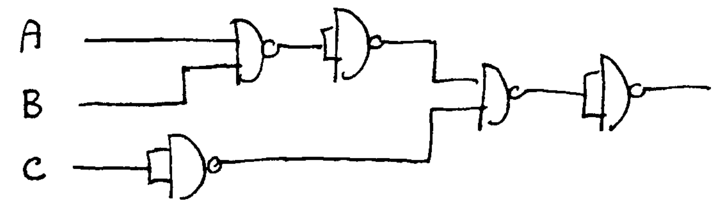
$$\boxed{Q = \overline{A}\cdot B}$$

7.) $A \cdot B \cdot \bar{C} = Out = \left(\overline{\bar{A} + \bar{B}}\right) \cdot \bar{C} = \overline{\overline{\left(\overline{\bar{A} + \bar{B}}\right)} + C}$

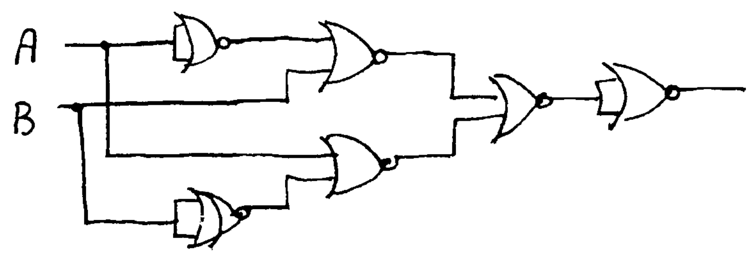
a.)



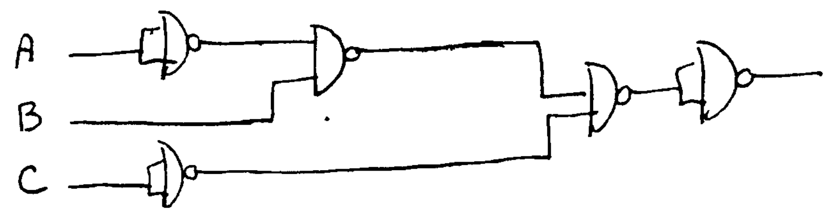
b.) $A \cdot B \cdot \bar{C} = Out = \overline{\overline{\left(\overline{A \cdot B}\right)} \cdot \bar{C}}$



c) $A \cdot \bar{B} + B \cdot \bar{A} = Out = \overline{\overline{\left(\overline{\bar{A} + B}\right) + \left(\overline{\bar{B} + A}\right)}}$



d.) $(A + \bar{B}) \cdot \bar{C} = Out = \overline{\left[\left(\overline{\bar{A} \cdot B}\right) \cdot \bar{C}\right]}$



Electronics set #6, P.7

8.) a.) $42|_{10} = (32 + 8 + 2)|_{10} = 101010|_2$

$\overset{2}{10}|\overset{A}{1010}|_2 = 2A|_{16}$

b.) $784|_{10} = (512 + 256 + 16)|_{10} = 11|0001|0000|_2 = 310|_{16}$

c.) $481|_{10} = (256 + 128 + 64 + 32 + 1)|_{10} = 1|1110|0001|_2 = 1E1|_{16}$

d.) $25|_{10} = (16 + 8 + 1)|_{10} = 1|1001|_2 = 19|_{16}$

e.) $106|_{10} = (64 + 32 + 8 + 2)|_{10} = 110|1010|_2 = 6A|_{16}$

f.) $10|_{10} = (8 + 2)_{10} = 1010|_2 = A|_{16}$

9.) a.) $15|_{16} = 0001|0101|_2 = 21|_{10}$

b.) $2C|_{16} = 0010|1100|_2 = 28|_{10}$

c.) $1AC|_{16} = 1|1010|1100|_2 = 428|_{10}$

d.) $EF|_{16} = 1110|1111|_2 = 239|_{10}$

e.) $20|_{16} = 10|0000|_2 = 32|_{10}$

f.) $A|_{16} = 1010|_2 = 10|_{10}$

Electronics, set #6, p.8

10.) a) 1011
+0101
10000

b) 11011
01100
100111

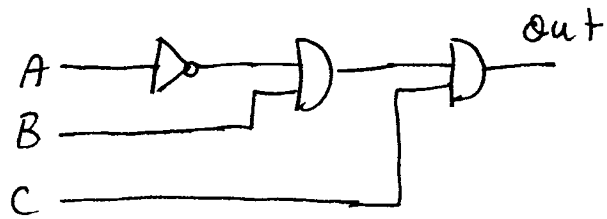
c) 11011
-01100 → 11011
+(10011+1)
1|01110
0|00001
1|01111
+

d.) 101101
-010110 → 101101
+(101001+1)
1|010110
0|000001
← 1|010111
+

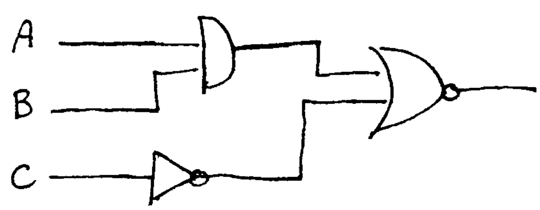
e.) 1001
-0110 → 1001
(1001+1
1|0010
0|0001
1|0011
+

f) 101101
+101001
1010110

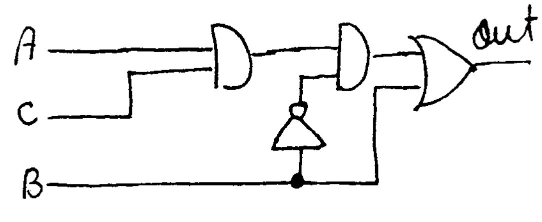
11.) a.) $Q = (\overline{A} \cdot B) \cdot C$:



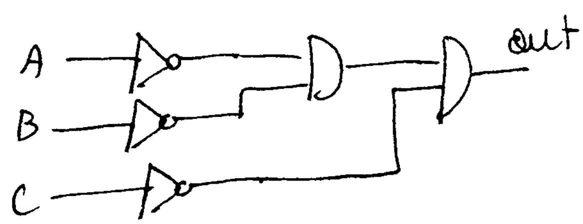
b.) $\overline{Q} = A \cdot B + \overline{C} \Rightarrow Q = \overline{A \cdot B + \overline{C}}$



c.) $Q = A \cdot \overline{B} \cdot C + B$:
$Q = (A \cdot C) \cdot \overline{B} + B$



d.) $Q = (\overline{A} \cdot \overline{B}) \cdot \overline{C}$:



12.) A : $A_1 A_0$ $A = B$ if and only if $A_1 = B_1$ and $A_0 = B_0$

B : $B_1 B_0$

$$\therefore \boxed{out = \left[(A_1 \cdot B_1) + (\bar{A}_1 \cdot \bar{B}_1)\right] \cdot \left[(A_0 \cdot B_0) + (\bar{A}_0 \cdot \bar{B}_0)\right]}$$

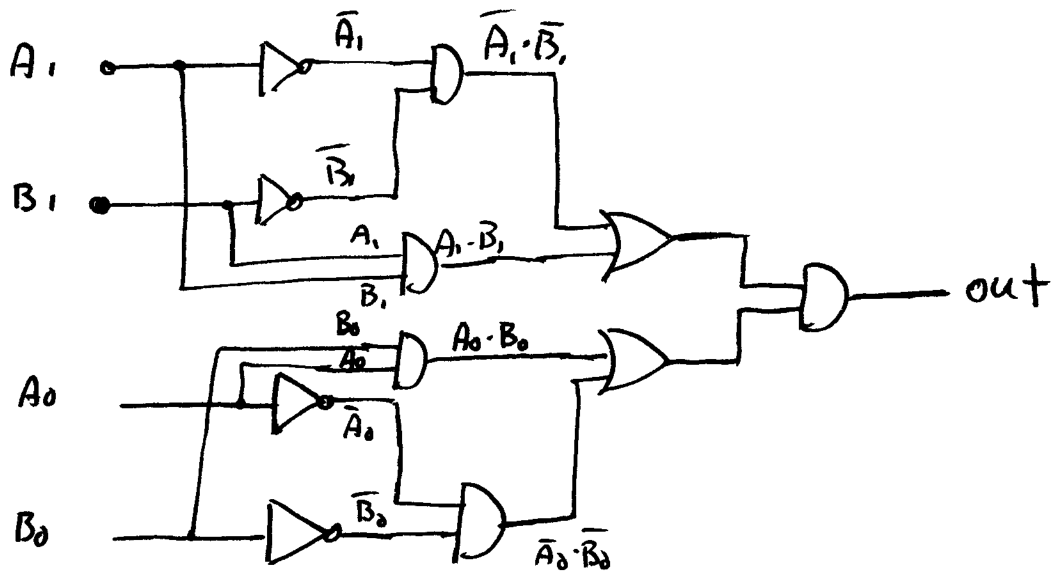
<u>note that</u> XOR yields an equality detection also since

$A \oplus B = 1$ only if $A \neq B$.

thus $\overline{(A \oplus B)} = 1$ only if $A = B$. this problem then becomes

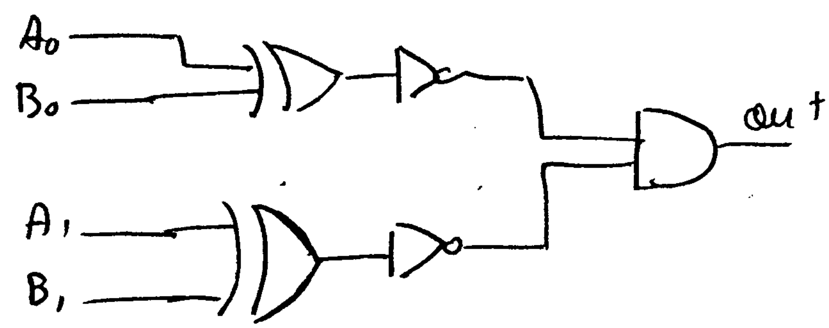
$$\boxed{out = \left(\overline{A_1 \oplus B_1}\right) \bullet \left(\overline{A_0 \oplus B_0}\right)} \left\{ = \overline{(A_1 \oplus B_1) + (A_0 \oplus B_0)} \right\}$$

13.) 1st answer:

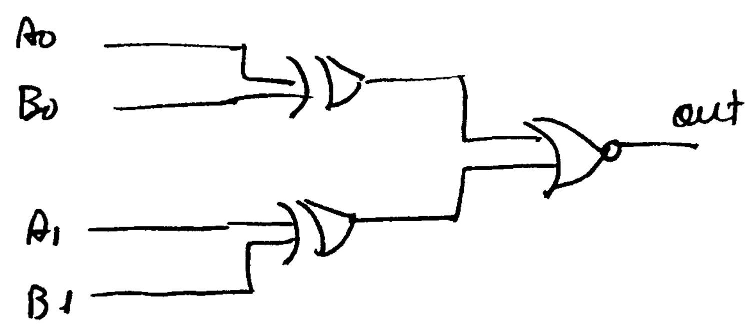


13.) Cout

2nd answer:



or



14.) A: A_1 A_0 $A > B$ if $A_1 > B_1$

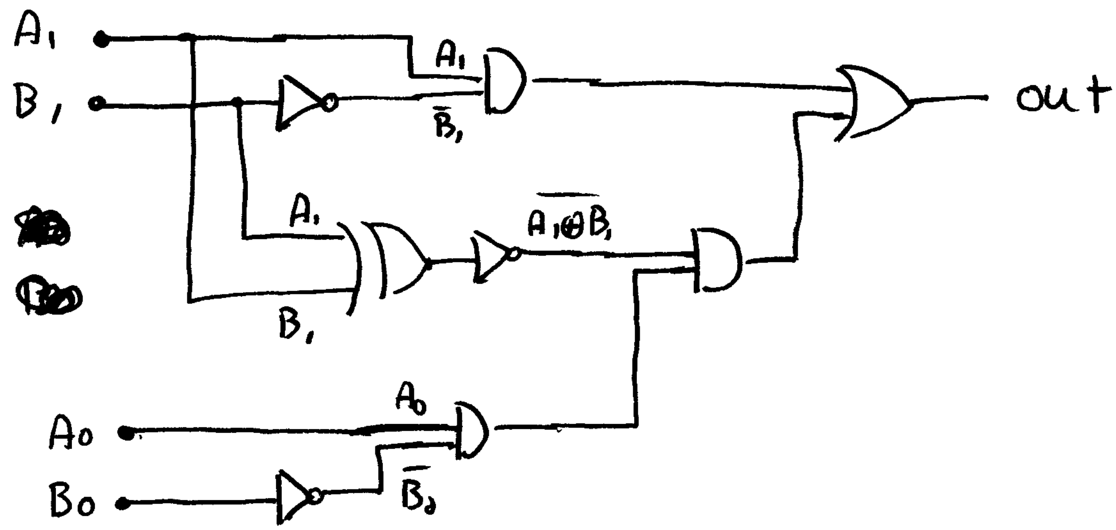
B: B_1 B_0

or $A_1 = B_1$ + $A_0 > B_0$

So

$$\boxed{out = A_1 \cdot \overline{B_1} + \underbrace{(\overline{A_1 \oplus B_1})}_{A_1 = B_1} \cdot (A_0 \cdot \overline{B_0})}$$

15.) from #14:



16. Individual terms :

A	B	C		out	
0	1	1	$\rightarrow$	1	$\bar{A} \cdot B \cdot C = \text{out}$
1	0	1	$\rightarrow$	1	$A \cdot \bar{B} \cdot C = \text{out}$
1	1	1	$\rightarrow$	1	$A \cdot B \cdot C =$

Basic Relation : $\boxed{\bar{A} \cdot B \cdot C + A \cdot \bar{B} \cdot C + A \cdot B \cdot C = \text{Out}}$

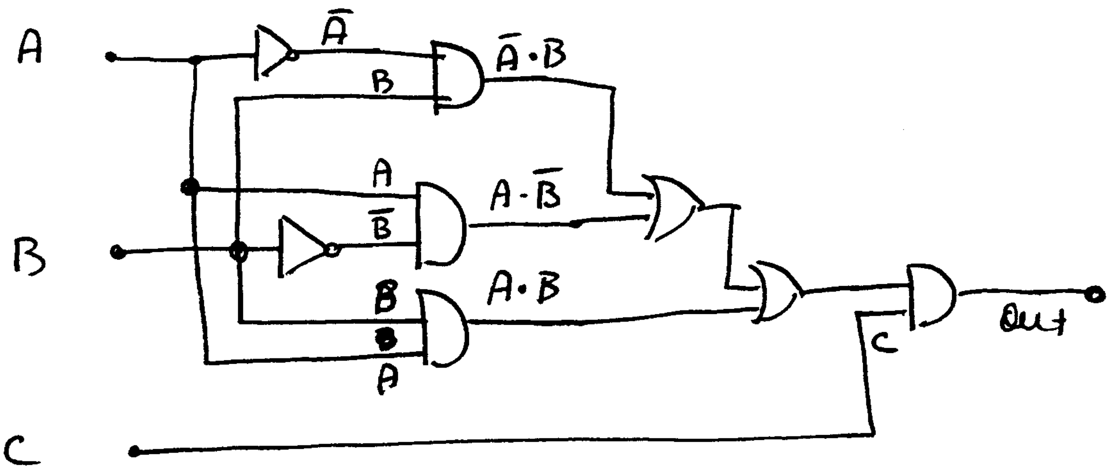
$$\left[\bar{A} \cdot B + \underbrace{A \cdot \bar{B} + A \cdot B}\right] \cdot C = \text{out}$$

$$(A \cdot \bar{B} + A \cdot B) = A \cdot (\underbrace{\bar{B} + B}_{1}) = A$$

Reduced relation (confirms) $\boxed{\left[\bar{A} \cdot B + A\right] \cdot C = \text{out}}$

16. Cout Circuits:

Basic relation:



Reduced relation: