EGC220
Class Notes
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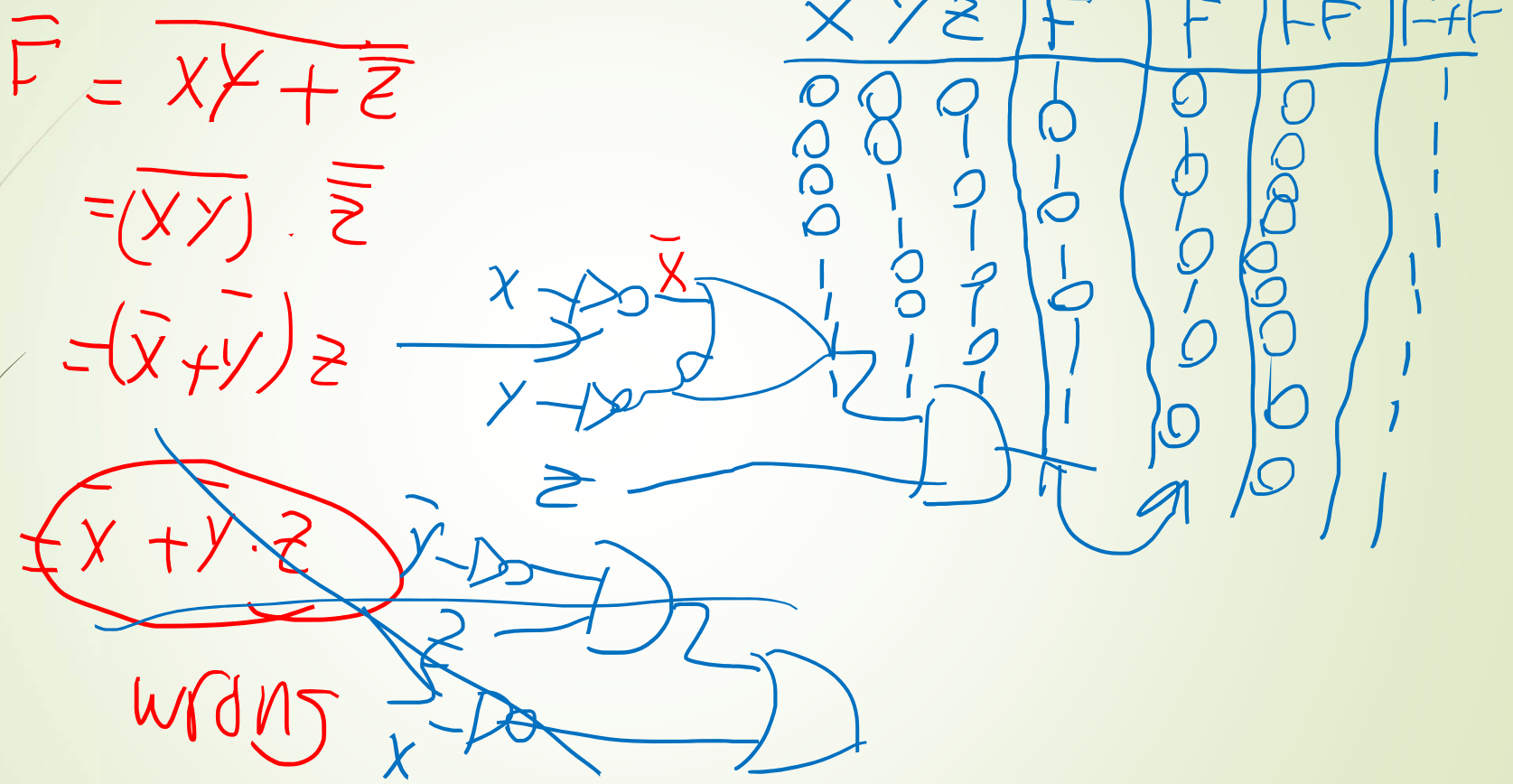
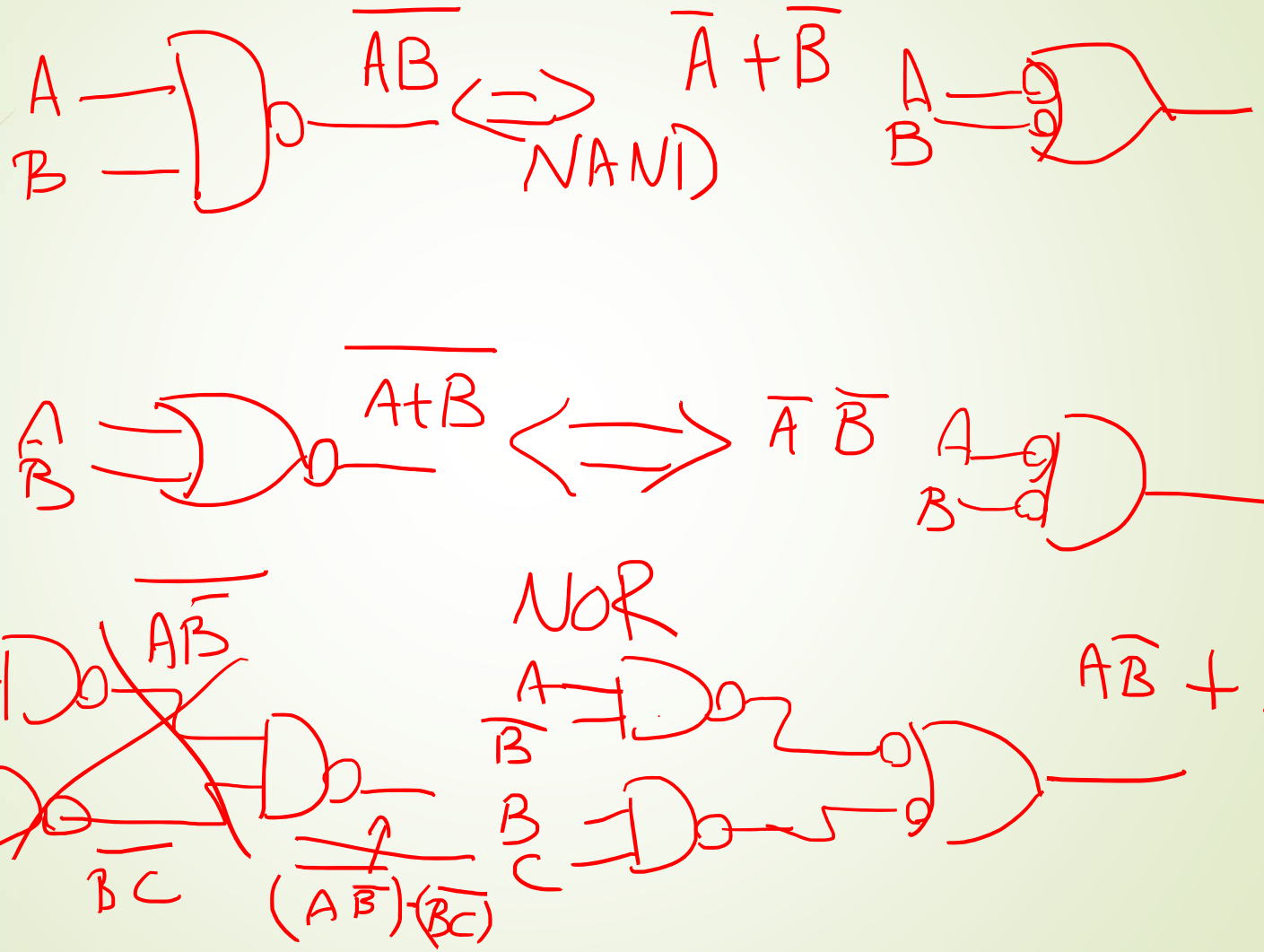
TABLE 2-6
Basic Identities of Boolean Algebra

1.	$X + 0 = X$	2.	$X \cdot 1 = X$
3.	$X + 1 = 1$	4.	$X \cdot 0 = 0$
5.	$X + X = X$	6.	$X \cdot X = X$
7.	$X + \overline{X} = 1$	8.	$X \cdot \overline{X} = 0$
9.	$\overline{\overline{X}} = X$		

10.	$X + Y = Y + X$	11.	$XY = YX$	Commutative
12.	$X + (Y + Z) = (X + Y) + Z$	13.	$X(YZ) = (XY)Z$	Associative
14.	$X(Y + Z) = XY + XZ$	15.	$X + YZ = (X + Y)(X + Z)$	Distributive
16.	$\overline{X + Y} = \overline{X} \cdot \overline{Y}$	17.	$\overline{X \cdot Y} = \overline{X} + \overline{Y}$	DeMorgan's

1. Find he complement of F = XY+Z'. Then show that FF' = 0 and F+F' =1




A
B
$\overline{AB}$
NAND
$\bar{A}+\bar{B}$
A
B
$\overline{A+B}$
$\bar{A}\,\bar{B}$
A
B
$\overline{A\bar{B}}$
$\overline{\bar{B}C}$
$(A\bar{B})+(\bar{B}C)$
NOR
$A\bar{B}+BC$

1. For function F = XY + XY' + Y'Z
   a. Truth table

X	Y	Z	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

   b. Sum of min terms

$F = \Sigma m(0,4,5,6,7)$

   c. Product of max terms

$F = \Pi M(0,2,3)$

   d. Standard sum of products

$F = \bar{X}\bar{Y}\bar{Z} + X\bar{Y}\bar{Z} + X\bar{Y}Z + XY\bar{Z} + XYZ$

   e. Standard product of sums

$F = (X+Y+Z)(X+\bar{Y}+Z)(X+\bar{Y}+\bar{Z})(X+Y+Z)$

   a. Minimum sum of products

$F = \bar{X}\bar{Y}\bar{Z} + X\bar{Y}\bar{Z} + XY\bar{Z} + X\bar{Y}Z + XYZ$

$= \bar{Y}\bar{Z}(\bar{X}+X) + XY(\bar{Z}+Z) + X\bar{Y}(\bar{Z}+Z)$

$= \bar{Y}\bar{Z} + XY + X\bar{Y} = \bar{Y}\bar{Z} + X(\bar{Y}+Y)$

$= \bar{Y}\bar{Z} + X$

   b. Minimum products of sums

$F = (X+Y+Z)(X+\bar{Y}+Z)(X+\bar{Y}+\bar{Z})$

$= (X+Z+Y\bar{Y})(X+\bar{Y}+Z\bar{Z}) = (X+Z)(X+\bar{Y})$

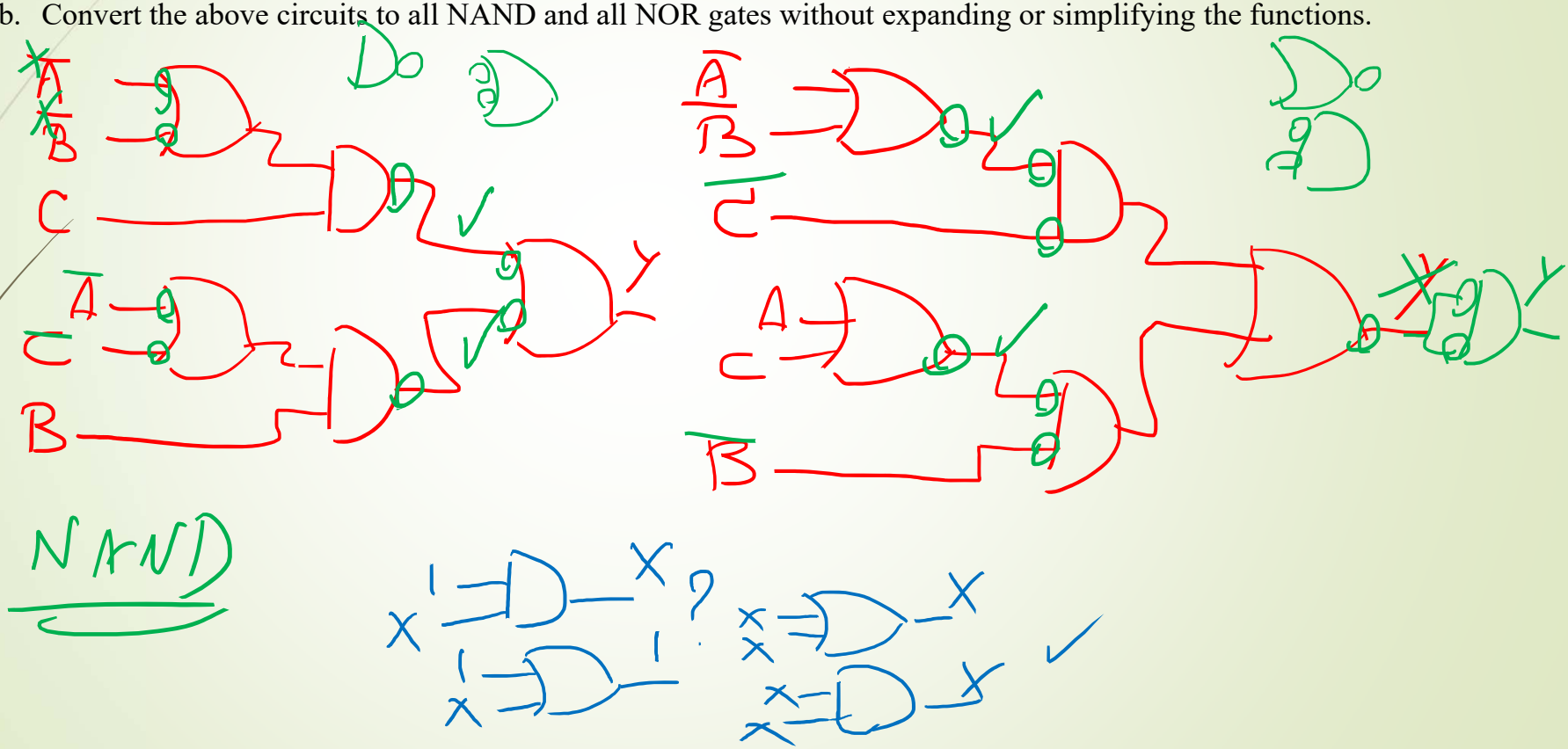
   c. Gate implementation using all NAND gates

only Min SOP

   d. Gate implementation using all NOR gates

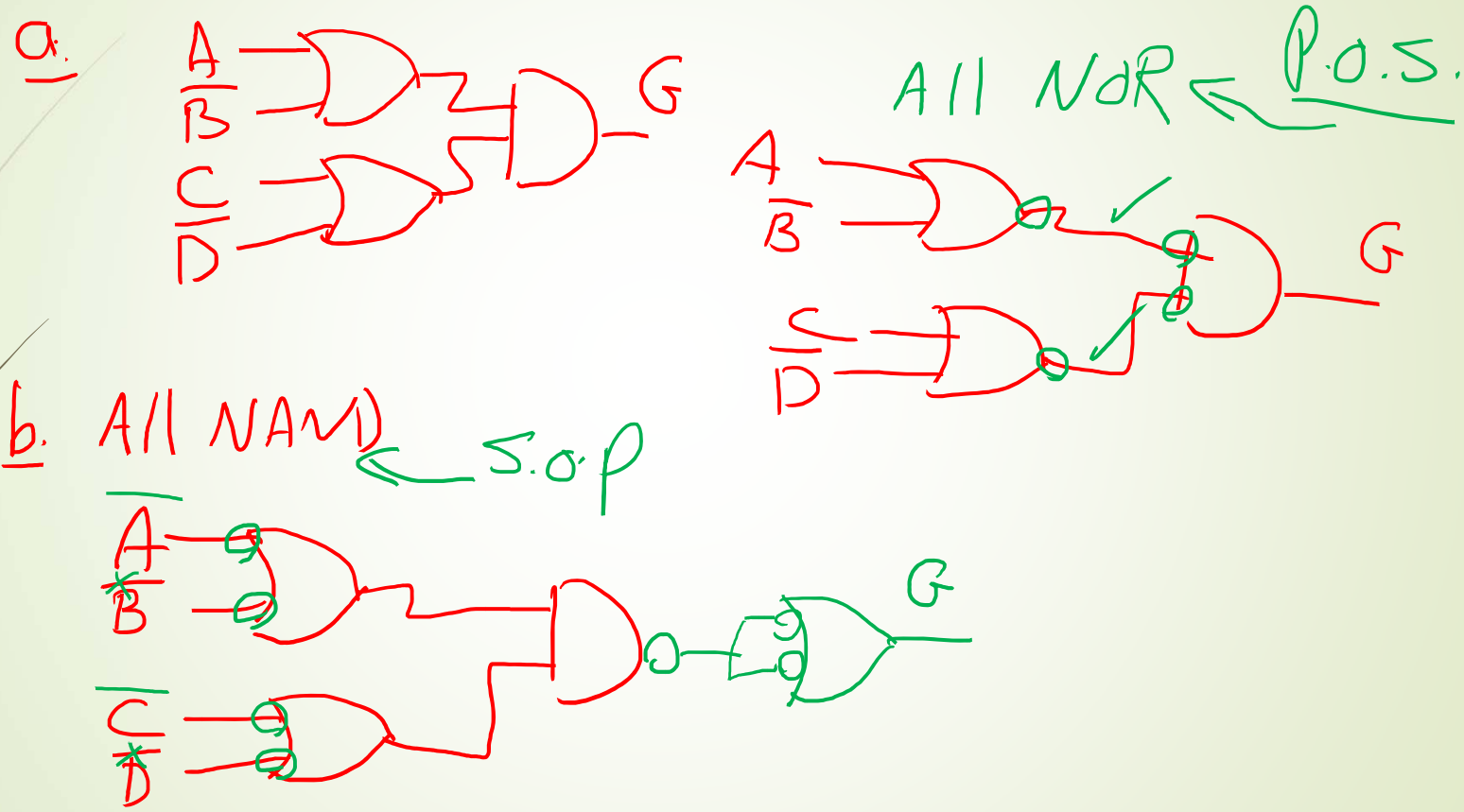
POS

a. Using AND and OR gates, draw the logic diagrams for the following Boolean expressions without expanding or simplifying them.
   i. Y = (A'+B')C + B(A+C)
   ii. ~~G= (A+B')(C+D')~~
b. Convert the above circuits to all NAND and all NOR gates without expanding or simplifying the functions.



a. Using AND and OR gates, draw the logic diagrams for the following Boolean expressions without expanding or simplifying them G= (A+B')(C+D')

b. Convert the above circuits to all NAND and all NOR gates without expanding or simplifying the functions.



1. For the following Boolean expression F = X'Y' + Y'Z + XZ + XY + YZ', determine
   a. Truth table
   b. Sum of min terms
   c. Product of max terms
   d. Standard sum of products
   e. Standard product of sums
   f. Minimum sum of products
   g. Minimum products of sums
   h. Gate implementation using all NAND gates
   i. Gate implementation using all NOR gates.

X	Y	Z	F
0	0	0	1 ✓
0	0	1	1 ✓ ✓
0	1	0	1 ✓
0	1	1	0
1	0	0	0
1	0	1	1 ✓ ✓
1	1	0	1 ✓ ✓
1	1	1	1 ✓ ✓

f. $F = \bar{X}\bar{Y} + Y\bar{Z} + XZ$

b. $F = \Sigma m(0,1,2,5,6,7)$

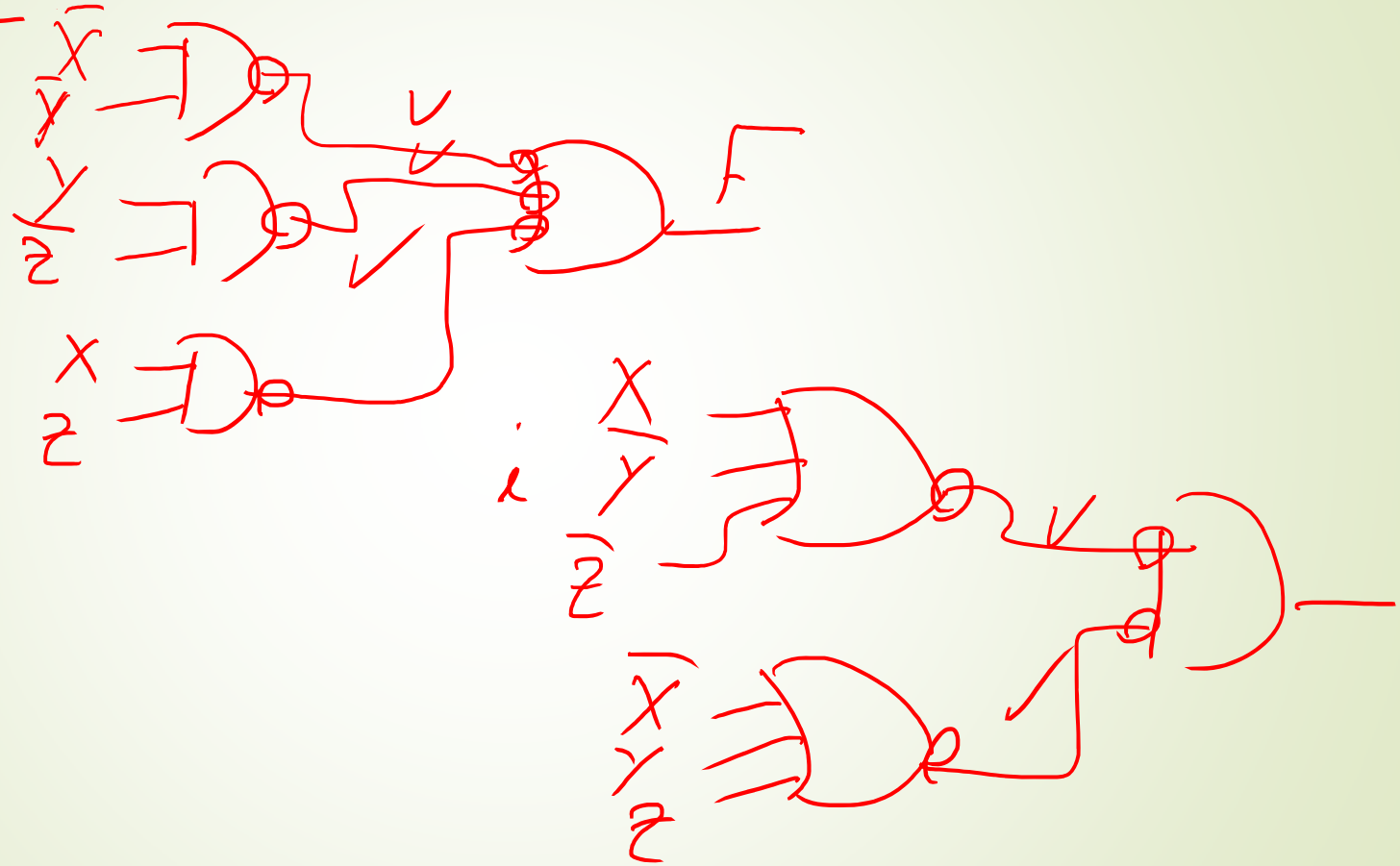
c. $F = \Pi M(3,4)$

d. $F = \bar{X}\bar{Y}\bar{Z} + \bar{X}\bar{Y}Z + \bar{X}Y\bar{Z} + X\bar{Y}Z + XY\bar{Z} + XYZ$

e. $\bar{F} = \bar{X}YZ + X\bar{Y}\bar{Z} \Rightarrow F = (X+\bar{Y}+\bar{Z})(\bar{X}+Y+Z)$

g. $F = (X+\bar{Y}+\bar{Z})(\bar{X}+Y+Z)$

h.



extra simplify

$F = \bar{X}YZ + X\bar{Y}Z + XY\bar{Z} + XYZ$

3 times

$XYZ \quad XY\bar{Z}$

$= YZ(\bar{X}+X) + XZ(\bar{Y}+Y) + XY(\bar{Z}+Z)$

$= YZ + XZ + XY$