Note Title 2/12/2009

- HW3 correction

1. Text problem 2.1 (a). Use first distributive law and simplify. (10 pts)
2. Text problem 2.1 (d). Use second distributive law and simplify. (10 pts)
3. Text problem 2.3. (d) Use second distributive law (or Theorem ~~12-14D~~ 10-14D). (10 pts)
4. Text problem 2.3. (e) Let X = {A′•B + D} and use second distributive law. (10 pts)
5. Text problem 2.5 (b). Let X = {A′ + C′} and use second distributive law. (10 pts)
6. Text problem 2.6 (a). First rewrite [A•B] + (C′•D′) = ([A•B] + C′) • ([A•B] + D′). Apply second distributive law to each new term. (10 pts)
7. Text problem 2.9 (a) (10 pts)
8. Text problem 2.13 (d), top of page 50. (10 pts)
9. Text Problem 4.21 (a). Multiply out the expression (first distributive law) and create a truth table. Express the truth table in **Σm ()** notation (rows numbers where the expression = 1). See pages 86 to 88). (10 pts)
10. Express the truth table for Problem 9 above in **ΠM ()** notation (rows where expression = 0). (10 pts)

* Test 1 on Monday!

See web site for procedural issues.

- Review 2's complement arithmetic
- De Morgan's Laws
- Conversion of circuits to Boolean expressions
- Conversion to sum-of-product form
- Laws and theorem on p. 52

How an 8-bit 2's compl. number is defined

$= (2^8 - A) = A^* \Rightarrow A = 2^8 - A^*$

$= (2^8 - 1 - A) + 1$

$A^* = (1\ 010\ 0101)_{2C}$

$A = (01011011)_2 = 1+2+8+16+64 = 91_{10}$

The original number is -91_{10}

$(0100101)_2 = 1+4+32 = 37$

$128 - 37 = 91$

So, the original number is -91_{10}.

Hex Table

HEX Digits

$0 = 0000_2$	$4 = 0100_2$	$8 = 1000_2$	C (12) = 1100_2
$1 = 0001_2$	$5 = 0101_2$	$9 = 1001_2$	D (13) = 1101_2
$2 = 0010_2$	$6 = 0110_2$	A (10) = 1010_2	E (14) = 1110_2
$3 = 0011_2$	$7 = 0111_2$	B (11) = 1011_2	F (15) = 1111_2

Laws and theorems (p. 52)

Operations with 0 and 1:

1. $X + 0 = X$ 1D. $X \cdot 1 = X$
2. $X + 1 = 1$ 2D. $X \cdot 0 = 0$

Idempotent laws:

3. $X + X = X$ 3D. $X \cdot X = X$

Involution law:

4. $(X')' = X$

Laws of complementarity:

5. $X + X' = 1$ 5D. $X \cdot X' = 0$

Commutative laws:

6. $X + Y = Y + X$ 6D. $XY = YX$

Associative laws:

7. $(X + Y) + Z = X + (Y + Z) = X + Y + Z$ 7D. $(XY)Z = X(YZ) = XYZ$

Distributive laws:

8. $X(Y + Z) = XY + XZ$ 8D. $X + YZ = (X + Y)(X + Z)$

Simplification theorems:

9. $XY + XY' = X$ 9D. $(X + Y)(X + Y') = X$
10. $X + XY = X$ 10D. $X(X + Y) = X$
11. $(X + Y')Y = XY$ 11D. $XY' + Y = X + Y$

DeMorgan's laws:

12. $(X + Y + Z + ...)' = X'Y'Z'...$ 12D. $(XYZ...)' = X' + Y' + Z' + ...$

Duality:

13. $(X + Y + Z + ...)^D = XYZ...$ 13D. $(XYZ...)^D = X + Y + Z + ...$

Theorem for multiplying out and factoring:

14. $(X + Y)(X' + Z) = XZ + X'Y$ 14D. $XY + X'Z = (X + Z)(X' + Y)$

Consensus theorem:

15. $XY + YZ + X'Z = XY + X'Z$ 15D. $(X + Y)(Y + Z)(X' + Z) = (X + Y)(X' + Z)$

12 and 12D are very important

13 and 13D define duality

14 and 14D are very useful for factoring & multiplying out, when converting to/from sum-of-products and product-of-sum forms

HW3 corrections

1. (2.1(a)) $X(X'+Y) = \left([8]\right) = XX' + XY = \left([5D]\right) = 0 + XY = [1] = XY$

distr. law

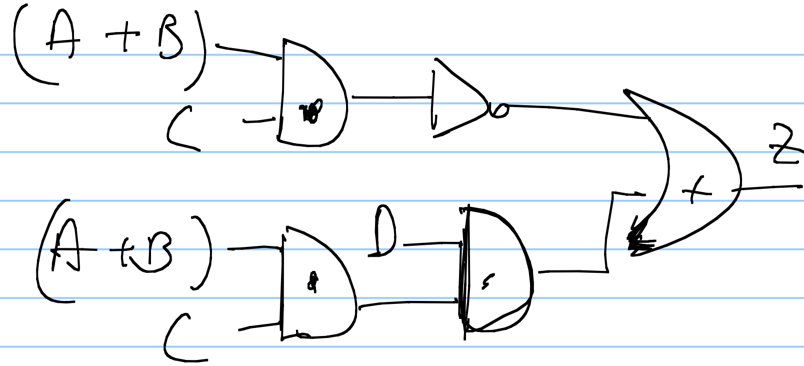
2. (2.1(d)) $= (A+B)(A+B') = \left([8D]\right) = A(A+B') + B(A+B') = ([8], \text{twice}) =$

$= AA + AB' + AB + BB' = \left([3D], [5D]\right) = A + AB' + AB = \left([8]\right) =$

$= A + A(B+B') = \left([5]\right) = A + A \cdot 1 = \left([1D]\right) = A + A = \left([3]\right) = A$

3. (2.3(d)) = done in class using prepared slides.

8 (2.13(d))

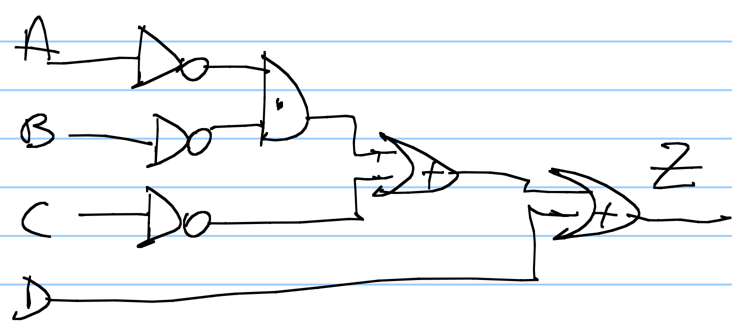


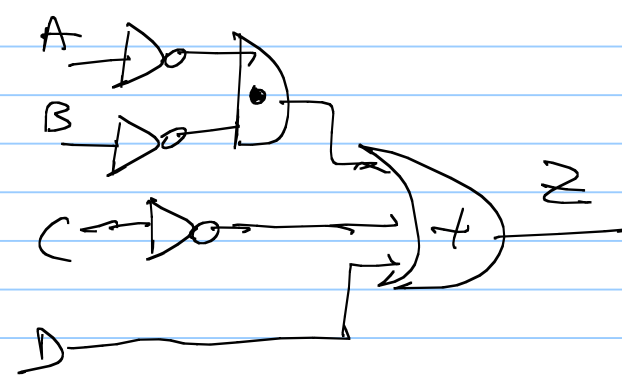
Note: bottom-up (left-to-right) conversion of circuit to expression.

$$((A+B)\cdot C)' + [(A+B)\cdot C]\cdot D = [11D] = D + ((A+B)\cdot C)' = \text{De Morgan} =$$

$$Y + XY' = X+Y$$

$$= D + A'B' + C' = A'B' + C' + D$$





9. 4.21(a) $f(a,b,c) = a'(b+c')$: express f as minterm expansion. (use m-notation)

$f(a,b,c) = a'b + a'c'$

$= \sum m(0,2,3)$

	a b c	$a'b$	$a'c'$	f
0	0 0 0	0	1	1
1	0 0 1	0	0	0
2	0 1 0	1	1	1
3	0 1 1	1	0	1
4	1 0 0	0	0	0
5	1 0 1	0	0	0
6	1 1 0	0	0	0
7	1 1 1	0	0	0

Or, keep expanding:

$f(a,b,c) = a'b + a'c' =$

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

$= a'bc + a'bc' + a'bc' + a'b'c' = a'bc + a'bc' + a'b'c' = \sum m(3,2,0) = \sum m(0,2,3)$

$\boxed{10.}$ $f(a,b,c) = \prod M(1,4,5,6,7)$