The University of Alabama in Huntsville
ECE Department
EE 202 – 02
Spring 2014
Test 1 Solution

x + 0 = x	x · 1 = x
x + x' = 1	x · x' = 0
x + x = x	x · x = x
x + 1 = 1	x · 0 = 0
(x')' = x	
x + y = y + x	xy = yx
x + (y + z) = (x + y) + z	x(yz) = (xy)z
x(y + z) = xy + xz	x + yz = (x + y)(x + z)
(x + y)' = x'y'	(xy)' = x' + y'
x + xy = x	x(x + y) = x

1. (1 point) _**True**_ (True/False) Complements are used in digital computers to simplify the subtraction operation.
2. (1 point)._**True**_ (True/False) Unsigned numbers represent only positive numbers.
3. (1 point) _**False**_ (True/False) Signed numbers represent only negative numbers.
4. (1 point) _**False**_ (True/False) Sum of products form is OR gates followed by AND gates.
5. (1 point) _**False**_ (True/False) All decimal numbers can be represented exactly in binary.

6. (10 points) Convert (231322_4) to decimal:

$$2 \times 4^5 + 3 \times 4^4 + 1 \times 4^3 + 3 \times 4^2 + 2 \times 4^1 + 2 \times 4^0 = 2 \times 1024 + 3 \times 256 + 1 \times 64 + 3 \times 16 + 2 \times 4 + 2 \times 1 = 2938_{10}$$

7. (5 points) For what value of x is the following equation true?

$25_x * 13_x = 347_x$

$(2x + 5)(x + 3) = 3x^2 + 4x + 7$
$2x^2 + 5x + 6x + 15 = 3x^2 + 4x + 7$
$2x^2 + 11x + 15 = 3x^2 + 4x + 7$
$x^2 - 7x - 8 = 0$
$(x + 1)(x – 8) = 0$

x = -1 or x = 8, only x = 8 is a valid solution

8. (10 points) Reduce ABC + A'B + ABC' to a minimum number of literals using Boolean algebra.

ABC + A'B + ABC' = A'B + AB(C + C') = A'B + AB = B(A' + A) = B

9. (10 points) Find the product of sums representation for the following function.
F(A, B, C) = $\Sigma(0, 1, 2, 4, 6)$

10. (20 points) Convert decimal +55 and +75 to binary, using the 8-bit signed-2's-complement representation. Then perform the binary equivalent of (-55) + (-75). Convert the answer back to decimal and verify that it is correct or explain why it is not.

+55 = 0 × -128 + 0 × 64 + 1 × 32 + 1 × 16 + 0 × 8 + 1 × 4 + 1 × 2 + 1 × 1 = 0011 0111
+75 = 0 × -128 + 1 × 64 + 0 × 32 + 0 × 16 + 1 × 8 + 0 × 4 + 1 × 2 + 1 × 1 = 0100 1011
-55 = 1 × -128 + 1 × 64 + 0 × 32 + 0 × 16 + 1 × 8 + 0 × 4 + 0 × 2 + 1 × 1 = 1100 1001
-75 = 1 × -128 + 0 × 64 + 1 × 32 + 1 × 16 + 0 × 8 + 1 × 4 + 0 × 2 + 1 × 1 = 1011 0101

-55 1100 1001
-75 1011 0101
0111 1110
0111 1110 =0 × -128 + 1 × 64 + 1 × 32 + 1 × 16 + 1 × 8 + 1 × 4 + 1 × 2 + 0 × 1 =
-64 + 32 + 16 + 8 + 4 + 2= 126 ×

The result doesn't match because -128 is the most negative number that can be represented in 8-bit signed-2's complement and -55 + -75 = -130. This is an overflow situation.

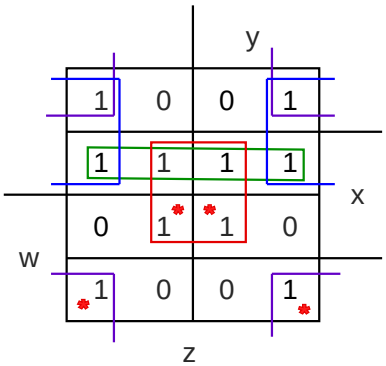
11. (5 points) Convert 00101010011100101010001111001010101001 to hexadecimal

0010_1010_0111_0010_1010_0011_1100_1010_1001 = $2A72A3CA9_{16}$

12. (5 points) Convert F(A, B, C, D) = $\Pi(1, 5, 6, 8, 9, 15)$ to the other canonical form.

F(A, B, C, D) = $\Sigma(0, 2, 3, 4, 7, 10, 11, 12, 13, 14)$

13. (15 points) Find all the prime implicants for the following Boolean function, and determine which are essential:
F (w, x, y, z) =Σ (0, 2, 4, 5, 6, 7, 8, 10, 13, 15)



14. (15 points) Simplify the following Boolean function, using four-variable maps:

F (w, x, y, z) = Σ(0, 2, 3, 6, 9, 12)
d (w, x, y, z) = Σ(4, 8, 10, 14)