Test 1 solution 50 minutes

All problems worth 10 points.

1. Convert the decimal number 311 to binary. Show your work.

311/2 = 155	rem 1	**1**
155/2 = 77	rem 1	**11**
77/2 = 38	rem 1	**111**
38/2 = 19	rem 0	**0111**
19/2 = 9	rem 1	**10111**
9 = 1001		**100110111**

2. Show the decimal equivalent of each of the numbers if they are interpeted as (six answers)

	0 1 1 0 0 1 1 1	1 0 0 1 0 1 0 1
a) Unsigned binary	103	149
b) Signed binary	+103	Magnitude: 01101011 -107
c) BCD (8421 code)	67	95

3. Add the two pairs of positive binary numbers. (Be sure to show the carry as you add.)

1 1 1 1	1 0 0 0
0 1 0 1 1 11	0 1 0 1 0 10
1 0 1 1 0 22	0 1 0 0 1 9
1 0 0 0 0 1 1	0 1 0 0 1 1 19
overflow	

Show both operands and the result of each addition in decimal as well as binary, indicating when there is overflow.

4. Complete the truth table for a system with 4 inputs, a, b, c, and d and one output, f. The first three inputs (a, b, c) represent a binary number, n, in the range 0 to 7; however, the input 0 never occurs. The last input (d) specifies which of two computations is made.

d = 0: f is 1 iff n is a multiple of 3
d = 1: f is 1 iff n is a multiple of 2

a	b	c	d	f
0	0	0	0	X
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
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

5. Use a truth table to show if $g_1 = g_2$, where

$g_1 = x' z' + y z$
$g_2 = (x' + z)(y + z')$

x	y	z	x' z'	y z	g_1	x' + z	y + z'	g_2
0	0	0	1	0	1	1	1	1
0	0	1	0	0	0	1	0	0
0	1	0	1	0	1	1	1	1
0	1	1	0	1	1	1	1	1
1	0	0	0	0	0	0	1	0
1	0	1	0	0	0	1	0	0
1	1	0	0	0	0	0	1	0
1	1	1	0	1	1	1	1	1

Truth tables are the same; they are equal

6. Reduce the expression below (using the algebraic properties) to a sum of products expression with 2 terms and 4 literals. Show each step.

a' b' c' + a' b' c + a b c + a b' c
= a' b' (c' + c) + a c (b + b')
= a' b 1 + a c 1
= a' b + a c

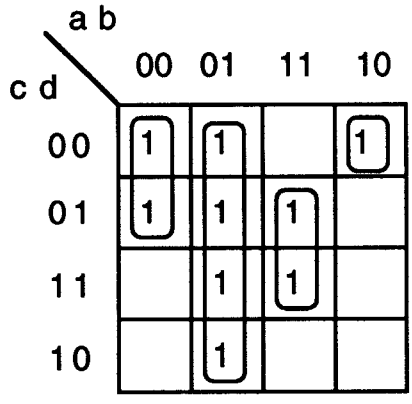
7. Reduce the expression below (using the algebraic properties) to a sum of products expression with 3 terms and 5 literals. Show each step.

x' y' z' + x' y' z + x' y z + x y' z + x y z + x y z'
= x' y' + x' y z + x y' z + x y
= x' (y' + y z) + x (y + y' z)
= x' y' + x' z + x y + x z
= z + x' y' + x y

or = z (x' y' + x' y + x y' + x z) + x' y' z' + x y z'
= z + x' y' z' + x y z'
= z + z' (x' y' + x y)
= z + x' y' + x y

8. Map the following function, circling each of the terms.

$$f = a'\,b'\,c' + a'\,b + a\,b\,d + a\,b'\,c'\,d'$$

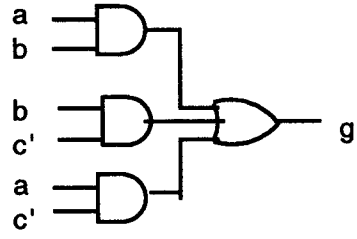


9. Consider the following function

$$g = a\,b + b\,c' + a\,c'$$

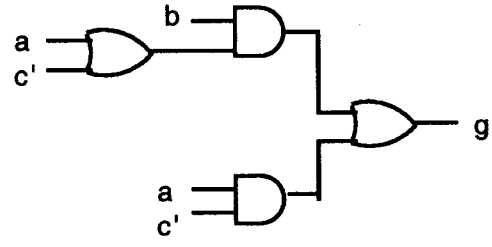
All inputs are available both uncomplemented and complemented.

a) Show a block diagram for a two-level AND-OR implementation.



b) Show a block diagram for an implementation that uses only two-input AND and OR gates.

$g = b\,(a + c') + a\,c'$ or $g = c'\,(a + b) + a\,b$



10. For the following truth table

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

a) Write a sum of minterms function in numeric form (for example, Σ m (0, ...)

f (x, y, z) = Σ m (0, 2, 3, 7)

b) Write a sum of minterms function in algebraic form (for example, x' y + ...)

f = x' y' z' + x' y z' + x' y z + x y z

c) Find a minimum sum of products expression (2 terms, 4 literals)

f = x' z' (y' + y) + y z (x' + x)
= x' z' + y z