

Test 2

50 minutes

All problems worth 10 points.

Problems 1 to 3 require algebraic solutions, NOT Karnaugh maps.

1. Reduce the following function to a sum of product expression with 3 terms and 6 literals. Use algebra and show each step.

$$f = wx + wy'z + w'xy + wxz + w'y'z$$

2. Reduce the following function to a sum of product expression with 3 terms and 6 literals. Use algebra and show each step.

$$g = a'c' + c'd' + b'c' + a'bc + b'cd$$

3. Convert the following expression to a sum of products expression. There is a 5 point bonus if you then reduce it to minimum sum of products form (3 terms, 6 literals)

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

For Problems 4 to 6, assume that all inputs are available both uncomplemented and complemented.

4. For the following function,

$$f(x, y, z) = \sum m(3, 4, 5, 7)$$

- a) Show a two-level NAND gate circuit to implement it. (3 gates)
- b) Show a two-level NOR gate circuit to implement it. (3 gates)

5. The following function is in minimum sum of products form. Implement it using only two-input NAND gates. No gate may be used as a NOT gate. Show both the block diagram and the equation. (Full credit for 8 gates.)

$$f = w'y'z + xy' + wyz + x'yz'$$

6. The following function is in minimum sum of products form. Implement it using only two-input NAND gates. No gate may be used as a NOT gate. Show both the block diagram and the equation. (Full credit for 12 gates; 2 extra points for correct solutions with less than 12 two-input gates; partial credit if you use one three-input gate.)

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

7. Find a minimum sum of products expression for

$$f(a, b, c, d) = \sum m (4, 5, 9, 11, 12, 13)$$

	00	01	11	10
00				
01				
11				
10				

8. Find a minimum sum of products expression for

		w	x			
	y	z	00	01	11	10
00			1			1
01				1	1	
11				1	1	
10			1	1		

9. Find both minimum sum of product expressions for (two copies of map shown for your convenience.)

		a b			
		00	01	11	10
c d	00	1			1
	01		1	1	
	11		1	1	
	10	1	1		1

		a b			
		00	01	11	10
c d	00	1			1
	01		1	1	
	11		1	1	
	10	1	1		1

10. Find both minimum sum of product expressions for (two copies of map shown for your convenience.)

		w x			
		00	01	11	10
y z	00	1	1		
	01	1	1	1	1
	11			1	1
	10	1	1	1	1

		w x			
		00	01	11	10
y z	00	1	1		
	01	1	1	1	1
	11			1	1
	10	1	1	1	1