Test 3 50 minutes

All problems worth 20 points.

1. For the following function, show as many minimum sum of products expressions as you can. The minimum is 5 terms and 13 literals. No credit for any solution that uses terms that are not prime implicants. (Four copies of the map are shown for your convenience.)

First solution: 8 points
Next two: 3 points each
Additional ones: 2 points each (up to a maximum of 26 points)

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

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

2. For the following function
   a) List <u>all</u> of the prime implicants and indicate which are essential.
   b) Find all 3 minimum sum of product expressions.

Four copies of the map are shown for your convenience.

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

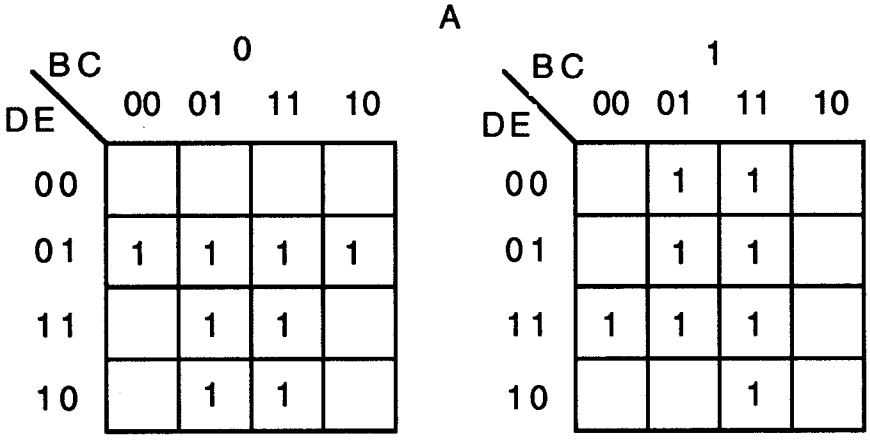
y z \ w x	00	01	11	10
00	1	X	X	1
01	1	X	X	
11			1	X
10		1	1	1

3. For the following function, show BOTH the minimum sum of products expression AND the minimum product of sums expression.

$$f(a, b, c, d) = \Sigma\, m(4, 10, 11, 12, 13, 14, 15)$$

Two blank maps are shown for your use.

4. For the following 5-variable function, find BOTH minimum sum of product solutions. (5 terms, 16 literals)



5. The following function is the only minimum sum of products expression. 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. Assume that all inputs are available both uncomplemented and complemented. (Full credit for 15 gates; partial credit if you use one three-input gate.)

$$F = B'C'D'E + BCD' + A'B'C + A'BC' + A'B'E' + ADE'$$