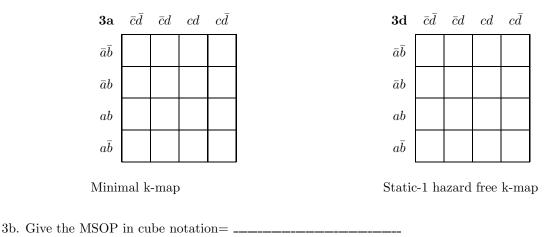
EECS 281:	Test $3 (5 pages)$	Due: Thursday, April 7, 2005
Name:	Email:	Grade: $\_$ (100 points max)

- 1. (10%) Please answer the following True or False in the context of Boolean Algebra:
  - T F  $\prod_{ab}(3) = \overline{a}\overline{b}$
  - $\mathbf{T} \quad \mathbf{F} \quad ab+abc=ab+abd$
  - T F  $\prod_{abc}(1,7,3,5,6) = \sum_{abc}(2,4,1,7,0)$
  - T F  $\sum_{ab}(3) = \overline{\overline{a} + \overline{b}}$
  - $\mathbf{T} \quad \mathbf{F} \quad ab\overline{c} + abc = ab\overline{d} + abd$

2. (10%) Use Boolean Algebra to establish the identity. Show the Theorem numbers (i.e. T1-T13) for each step of your proof:

Theorem	Expression
	$1 = a(a+b) + (\overline{a}+b)(a+\overline{b}) + \overline{a}\overline{b}$

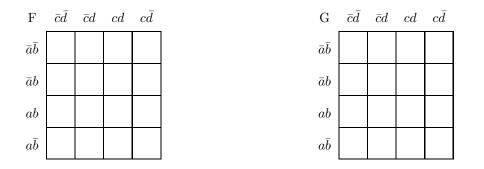
3a. (20%) Show the optimal minimal circling in the k-map in minterm function  $\prod_{abcd} (2,3,5,7,8,9,13,15)$  in the left-hand figure below.



3c. Give the MSOP in symbolic boolean algebra= \_\_\_\_\_

3d. Show the optimal k-map designed to cover static-1 hazards in the right-hand figure above.

4a. (20%) Show the optimal multi-output minimal circling the terms and in the k-map in minterm function  $F = \sum_{abcd} = (2, 3, 5, 7, 8, 9, 13, 15)$  and  $G = \sum_{abcd} = (2, 3, 4, 6, 8, 9, 12, 14)$ . Indicate which circle belongs to what function.



4b. Give the boolean algebra common term of multi-output MSOP = \_\_\_\_\_

4c. Give the boolean algebra multi-output MSOP of F= \_\_\_\_\_

4d. Give the boolean algebra multi-output MSOP of  $G = \_$ 

4e. Draw and fill in the PLA:

Group	Minterms	0-cubes	Minterms	1-cubes	Minterms	2-cubes
$G_0$						
$G_1$						
$G_2$						
$G_3$						
$G_4$						

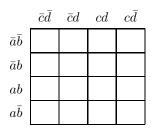
5a. (20%). Do the Quine-McCluskey Algorithm of  $\sum_{a,b,c,d} (2,3,5,7,8,9,13,15)$ .

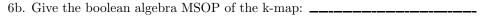
5b. Fill in the covering table

EPI?	PI-cubes					
	Covered?					

5c. Give the boolean algebra MSOP= \_\_\_\_\_

6a. (10%) Given  $\sum_{a,b,c,d} (2,3,5,7,8,9,13,15)$  and the don't cares (1,11,14), show the optimal k-map:





7. (10%) A programmer has written the following C code fragment (assume variables are 1-bit):

f=0; if ( (a | b) & c){ if (b) { f=1; } } else if (a & b) { f=0; }

7a. Give the truth table for the variable f (assume that a, b, c are boolean values only):

7b. Give the optimal k-map of 7a.



7c. Give the boolean algebra MSOP of the k-map: \_\_\_\_\_

7d. Re-write as optimal C code:

x1. (5% Extra credit) Write the C language for-loop for the recurrence equation,  $t_n = 2t_n + n - 1$ , where  $t_0 = 2$ .

x2. (10% Extra credit) Write the 8051 assembler for the recurrence equation of problem x1, use R0 for variable i, R1 for variable n, R2 for variable t.

Theorem	Relationship	Dual	XOR	Property
T1	a1 = a	a + 0 = a	$a \oplus 0 = a$	Identity
Τ2	a0 = 0	a + 1 = 1	$a \oplus 1 = \overline{a}$	Domination
Т3	aa = a	a + a = a	$\begin{array}{c} a \oplus a = 0 \\ a \oplus a \oplus a = a \end{array}$	Idempotency
Τ4	$\overline{\overline{a}}$			Involution
T5	$a\overline{a} = 0$	$a + \overline{a} = 1$	$a \oplus \overline{a} = 1$	Complement
Т6	ab = ba	a+b=b+a	$a \oplus b = b \oplus a$	Commutative
Τ7	(ab)c = a(bc)	(a+b) + c = a + (b+c)	$(a \oplus b) \oplus c = a \oplus (b \oplus c)$	Associative
Т8	(a+b)(a+c) = a+bc	a(b+c) = ab + ac	$a(b\oplus c)=ab\oplus ac$	Distributive
Т9	a(a+b) = a	a + ab = a	$a \oplus ab = a\overline{b}$	Absorption Covering
T10	$(a+b)(a+\overline{b}) = a$	$ab + a\overline{b} = a$	$ab\oplus a\overline{b}=a$	Combining
T11	$(a+b)(\overline{a}+c)(b+c) = (a+b)(\overline{a}+c)$	$ab + \overline{a}c + bc = ab + \overline{a}c$		Consensus Proof by k-map
T12	$a + a + \dots + a = a$	$aa\cdots a = a$	$\begin{array}{c} a \oplus a \oplus \cdots \oplus a_{odd} = a \\ a \oplus a \oplus \cdots \oplus a_{even} = 0 \end{array}$	Generalized Idempotency
T13	$\overline{a+b} = \overline{a}\overline{b}$	$\overline{ab} = \overline{a} + \overline{b}$	$\overline{ab} = \overline{a} \oplus \overline{b} \oplus \overline{a}\overline{b}$	DeMorgan
XOR	$ab = a \oplus \overline{b} \oplus \overline{a}\overline{b}$	$a+b=a\oplus b\oplus ab$	$a \oplus b = \overline{a} \oplus \overline{b} = a\overline{b} + \overline{a}b$	Definition