CSE 370

Sample Midterm 1

Winter 2009

Problem 1:

(10 pts) (a) Use De Morgan's theorem to find the complement of

$F = (\overline{A}(B + C) + \overline{C})(A + B) + \overline{ABC}$

using negations only in literals - no double negations.

(10 pits) (b) Simplify $F = (B + C)(A+ B)(A+1) + A\overline{C}$

Problem 2:

Consider $F (A, B, C, D) = \prod M(1,2,3,4,5)$

(8 pts) (a) Write down the Boolean expression of F in the canonical 'product of sums' (i.e. maxterm) form.

(6 pts) (b) For a canonical 'product of sums' logic circuit, how many OR and AND gates do you need? Also specify the number of inputs for thos OR and AND gates you use (so you answer should in the form of "three 3-input OR gates and two 2-input AND gates", for example.
(HINT: if you are unsure, draw a schematic of the circuit so that partial credit may be given.)

(6 pts) (c) Now do the same as (b) for a canonical 'sum of products' logic circuit. How many OR and AND gates do you need? Also specify the number of inputs for those OR and AND gates.

Problem 3:

Given $F = ABC + A\overline{BC} + \overline{A}B\overline{C}$, draw a logic gate circuit for $\overline{F}$ (inverted F) in 'product of sums' form as follows:

(10 pts) (a) With OR/AND gates only (can use inverters)

(10 pts) (b) With NAND gates only (can use inverters)
(HINT: This is where you should push bubbles)

Problem 4:

For the following truth table,

(7 pts) (a) Build the Karnaugh map
(7 pts) (b) Identify all the sub-cubes (max size, min number) on a separate copy of your K-map.
(6 pts) (c) Provide a minimum canonical 'sum of products' expression for F.

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	X
0	1	1	0	X
0	1	1	1	X
1	0	0	0	1
1	0	0	1	X
1	0	1	0	X
1	0	1	1	0
1	1	0	0	1
1	1	0	1	X
1	1	1	0	1
1	1	1	1	0

Problem 5:

Solve the following questions for function F (A,B,C,D) = Σ m(2,3,8,10,13,14)

(10 pts) (a) Express F using one 8:1 Multiplexer (can use inverters and NOR gates also)

(10 pts) (b) Express F using one 4:1 Multiplexer (can use inverters and NOR gates also)