CS 150: Spring 1994
Midterm #2
Professor A. R. Newton

(Open Katz, Calculators OK, 1hr 20 min)

Include all final answers in locations indicated on these pages. Use space provided for all working. If necessary, attach additional sheets by staple at the end. BE SURE TO WRITE YOUR NAME ON EVERY SHEET. Postulates & Theorems are sumarized on page 10 for your convenience.

Problem #1

(A) Represent the following sentences by two Boolean equations:

"The tape drive motor for a VCR should be running forwards iff:

(i) a tape is in the machine,

(ii) the play button has been pressed or the fast-forward button has been pressed

(iii) the end-of-tape signal is not present

The motor should be running backwards iff:

(iii) a tape is in the machine,

(iv) the rewind button has been pressed

(v) the already-rewound signal is not present

Otherwise, the motor should not be running at all."

1(a)(6 pts) Definition of terms:

Boolean Equations:

(1)

(2)

(b) Given that F = AB+AC+CD+BC'D' (note: A' means complement of A, or A with a bar over it)

(i) Use a Karnaugh map to find the maxterm respresntation of F. Express your answer in standard form.

(ii) Use the K-map to find the minimum sum-or-products form for F'. Express in algebraic form.

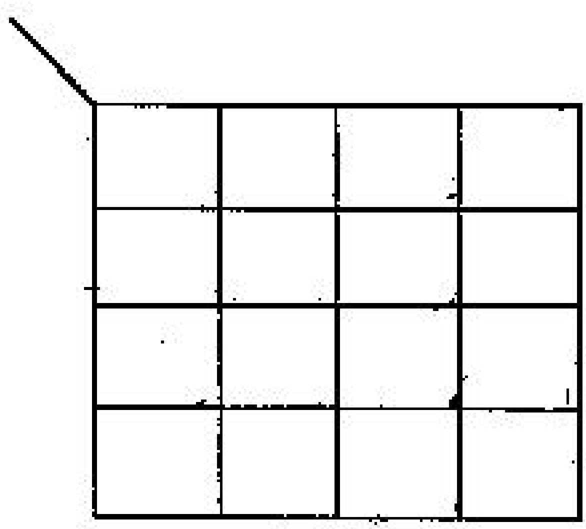
(iii) Find the minimum product-of-sums for F. Express in algebraic form.

1(b)(9 pts)

(i) Maxtem representation: F=

(ii) Minimum S-of-P form: F' =

(iii) Minimum P-of-S form: F =



Problem #2

(2)(a) Implement the function, F, shown on the Karnaugh map below using a minimum number of logic gates and gate inputs. Assume complements are available.

(b) Repeat (a) above using a minimum number of 2-input NAND gates only. Assume complements are available.

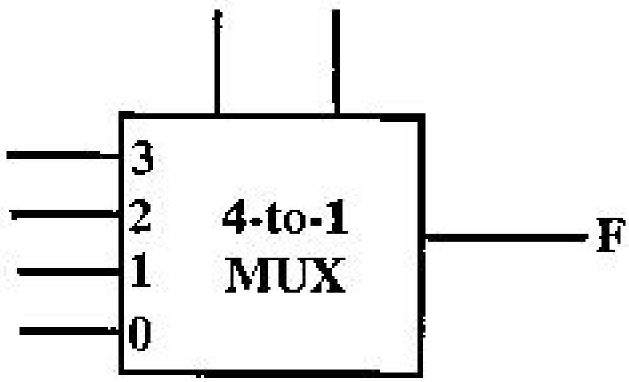
(c) Repeat (a) above using a 4-to-1 MUX and logic gates (INV,AND,OR,NAND,NOR,XOR or XNOR). Select the control inputs so as to minimize the number of additional gates needed. Assume complements are available.

CD \ AB	00	01	11	10
00	1_0	1_4	0_{12}	0_8
01	1_1	1_5	1_{13}	0_9
11	0_3	1_7	1_{15}	1_{11}
10	0_2	0_6	1_{14}	1_{10}

2(a)(5pts)

2(b)(5pts)

2(c)(5pts)



Problem #3

(3)(a) Use two-input NAND gates to convert a positive-edge-triggered T flip-flop to a D flip-flop. Show all working - most points will be given for your working.

3a)(10pts)

(b)Does your combinational logic include a hazard? Explain why or why not. If it does contain a hazard, show how it can be removed.

3(b)(5pts)

Problem #4

(4)(a)The binary string "10101101" is the 8-bit two's complement represntation of a fixed point number. What is its decimal value?

4(a)(3pts)

(b) Design a circuit to compute the two's complement of a 3-bit binary number. The inputs are b_0, b_1 and b_2, where b_2 is the most significant digit and the outputs are c_0, c_1 and c_2 where c_2 is the most significant digit.

(i) Show a truth table for the circuit.

(ii) Draw Karnaugh maps for each output and use them to simplify the functions.

(iii) Draw a schematic diagram using the minimum number of NAND gates and inverters only.

4(b)(12pts)

(i)Truth table (3pts):

(ii)Karnaugh Maps (3pts):

(iii)Schematic Diagram (6pts):

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